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A

MANUAL

OF

INFORMATION AND SUGGESTIONS

FOR

OBJECT LESSONS,

IN A COURSE OF

ELEMENTARY INSTRUCTION.

ADAPTED TO THE USE OF THE

SCHOOL AND FAMILY CHARTS,

AND OTHER AIDS IN TEACHING.

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By MARCIUS WILLSON,

AUTHOR OF "WILLSON'S HISTORICAL SERIES," "SCHOOL AND FAMILY READERS," &c., &c.

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☞ See the APPENDIX for an "Approximate Programme" of a course of Elementary Instruction during the first ten years of school life; a collection of Maxims and Mottoes for School Use; Table of Contents; and a complete Index.

INTRODUCTORY.

THE PRINCIPLES ON WHICH THE SYSTEM OF OBJECT TEACHING IS BASED.

1. The System not New in Principle.

The system of instruction by "object" teaching, as it has been called, but which we should prefer to call the *Development* System, is nothing new in principle or purpose; for it is fully carried out in Nature's teachings in the early years of childhood; and it is the system upon which nearly all valuable knowledge has been accumulated in the progressive civilization of the race. It is to a degree, however, new in its application to the methods of early school instruction, in which we think we shall show we have most departed from Nature and from enlightened experience.

2. Nature's System of Teaching.

It is known that the child, from one to four years of age, acquires knowledge far more rapidly than at any subsequent period of life. In these three years it has attained great proficiency in a language of peculiar intricacy, speaking it with considerable fluency, and mastering many of its most difficult idioms; it has learned to recognize, and give the names, and know many of the qualities and uses of a thousand objects; and this it has done by keeping the senses of touch, taste, hearing, sight, and smell—the perceptive faculties—in almost constant and pleasurable activity. These active workers have seldom wearied of their self-imposed labors, and never been injured by over-exertion; for the natural exercise to which they have been subjected has been to them health and strength, and the in-

terest the mind has taken in their acquisitions has made every toil a pleasure. And yet, at this period of life, all the powers and faculties are comparatively feeble, so that we are forced to the conclusion that whatever the mind has accomplished is attributable chiefly to the *system* of instruction which has been pursued.

Nor is it the mere acquisition of knowledge that has been thus early accomplished. The perceptive faculties have had that kind of training which has peculiarly contributed to give them accuracy and vigor: the attention has been cultivated by presenting to it objects of interest and of suitable variety: memory has been pleasurably, and hence profitably exercised: reason and judgment have had presented to them the materials for their early cultivation; and the germs of the moral nature have been developed in the early emotions of infantile joy and sorrow, followed by feelings of sympathy, and the first notions of right and duty.

We believe there are some very important principles in this system of Nature's teaching, that should be considered and adopted in arranging a system of school instruction. We purpose to point out a few of these principles, hoping, by showing how far we have departed from them, to indicate a system more in accordance with that of Nature.

3. Early Development of the Perceptive Faculties.

What are, then, the means by which the child acquires all its materials of knowledge? It may seem a truism to answer that the means or instruments are THE SENSES, which we may class together as forming the PERCEPTIVE FACULTIES; and yet the truth seems overlooked, if we are to judge from the little attention given to the principles upon which they act, and the proper means of their education. The perceptive faculties are developed in early childhood by appropriate *exercise* upon the objects which are presented to them: and we think the great desideratum is to discover the *principles* upon which they have thus been exercised in the school of Nature. Let us first take the

senses of sight and hearing—the most important of our senses in an educational point of view—and inquire *in what order* knowledge is obtained through them, that we may learn, if possible, *where to begin* in the presentation of any subject to children.

4. The "Elementary" Theory—generally adopted.

"Begin with the elements" of a subject, says one: "Reduce every thing to its elements," has become a stereotyped phrase with educators. We are asked, "What can you have more simple than the elements of a subject; and shall we not begin with them?" This is, indeed, the fundamental principle on which our systems of primary education have been based; and the *theory* looks like a very plausible one. In fully carrying out this system, we are told, when we come to teach the *alphabet*, that the letters are formed by combinations of certain *elementary lines*, straight and curved, and that the true method is to teach the *elements* first, by which the compound may be thoroughly understood. The same theory directs that we should begin with similar elements—with the most elementary lines—in writing and in drawing. In *reading*, we are told that the spoken words are formed by combinations of certain *elementary sounds*, and therefore the pupil must begin with these. It is true that all these so-called elements are wholly *unmeaning* things to the child—that they have no *ideas* connected with them; but what of that? In teaching *spelling* we come as near to the elementary system as possible, by giving long columns of mere *words* to be spelled, not one in twenty of which has any meaning to the child. In *arithmetic* we begin with certain marks or signs, called digits, because these *represent* the *elements* of arbitrary numbers. In *grammar* we begin by taking a sentence, and teaching a child the subject, predicate, object, attribute, etc., because these are said to be the *elements* of the language. In *geography* we begin by teaching the infantile mind the form of the earth, perhaps its place in the solar system, its zones, latitudes and longitudes, and great divisions of land and

water, because these things are supposed to be the *elementary* parts which make up the science of geography, and as if these were the first things which mankind learned about the earth, instead of being the last. These are sufficient illustrations of the principles on which our systems of education have been based. Let us now look at Nature's system, under which the child had progressed so finely during its early years, and see if the two harmonize.

5. Nature's System—How opposed to it.

The child early learns to recognize a great variety of surrounding objects, and to designate them by their appropriate names. Thus, an object is presented to the sense of sight, causing *sensation:* if attention be sufficiently directed to the sensation, the latter is followed by *perception*, when an *idea*, *image*, or *representation* of the object is presented to the mind. Language now seeks an expression—a word or *name*—by which to represent the idea. Here the order of sequence, as in all cases of *Nature's* teaching, is, first the *idea*, and then the *word* to express or represent it; and it will be found that Nature never inverts the order; never takes a step in instruction that requires a *sign* to be learned before the *thing signified* is presented. This is as true as that sensations and perceptions precede ideas, and as certain as the truism that the mind can never give expression or representation to what it does not possess; and when the attempt is made to present to the mind *words* and *signs* before the *ideas* and *things signified*, Nature is outraged, and the fundamental principles of education are violated. It is very probable, therefore, that Nature's method is the true one, for it is based upon the *only* order in which the mind acquires knowledge. Let us use this principle to test some of our methods of instruction.

I will suppose that a child four years of age is placed in my charge, and that I am to commence its school instruction. Its perceptive faculties have already received considerable culture from the tutelage of its first teacher, Nature: it has acquired considerable knowledge of surround-

ing objects, and all in the order of sensations, perceptions, ideas, *words*. It can use *spoken* words, but has not learned to recognize the printed representations of them. I wish to teach it to read, and first take up the *alphabet* for that purpose, because I have been told that I must begin with the *elements* of the printed words. I commence with A, B, C; but I can associate, in the mind of the child, no *ideas* with them; and the rule which Nature has given me is, *ideas* before signs. The child has no ideas of which these marks are the signs.

Another theoretical educator comes along, and tells me I have not reduced the subject to its simplest elements; that there is something even more elementary than the letters of the alphabet, for these letters are compounded—made up—of elementary straight and curved lines. I then begin with these supposed elements, and attempt to teach the child all the forms of the *lines* that enter into the structure of the letters. But, alas! the process seems more and more tedious the nearer I get to the *ultimate* elements, and when again I revert to the rule of the great teacher, Nature, I find I am still violating its principles, even more, if possible, than before.

At this time another beautiful theory is presented to me: I am told to leave the alphabet for the present, and to begin to teach reading with *words*. This surely, I think, must be the natural order, for the child uses *words* before it is taught the *letters* which compose them. But, in order to learn to read and speak the printed words, I am told that the child should first learn the *elements* of the spoken words, that is, the *elementary sounds* of the letters; for these, it is very evident, the child uses in speaking a word —and it could not speak a word without using them. It does not occur to me that this beautiful *elementary theory* would require a knowledge of the nerves and muscles of the arm before the arm should be allowed to be used in the practice of muscular motion! I proceed with the prescribed method, and, presenting to the child the separate letters of the word *cap*, I teach it their *elementary sounds*:

then I tell the child to combine these three elements, and am gratified to find that the compound is the spoken word *cap!* I have taught the child to pronounce the word *elementarily!* But when I look more closely at this process, I find that I presented to the child the *word* cap before the idea; and also that these *elementary sounds* were not preceded by any *ideas* of which they were the *representatives!* Even this, therefore, can not be *Nature's* method, nor in accordance with the natural development and use of the mental faculties. I am satisfied, therefore, that I have not yet discovered the natural method of teaching reading, and must begin anew.

I now present to the child a real object—a *cap.* Suppose it had never seen one before. The object produces, through the organ of sight, a *sensation:* if sufficient attention be given, *perception* follows, connecting the sensation with the object, and an image or idea of the object is then formed in the mind. Now, for the first time, a *word,* a *name,* is wanted, to give outward expression in language to the idea. If some particular articulate sound is now given the child to meet this want, it ever after represents the object by that sound or name. The idea, the want, has come before the representative sign.

But how does Nature teach us to represent the idea or image of the object to the eye? First by a *picture* of the object, as we see in the picture-writings of all nations emerging from a state of barbarism. After a time the picture is dropped, and more arbitrary but more convenient marks or signs are substituted, as we find in the arbitrary letters and words of our printed language. The printed *word,* however, like the *picture,* represents, by association, the object, or the idea which perception gives of it; and as in nature it never precedes the idea, so it should not in our teachings.

Suppose, then, that the child has already learned to recognize numerous printed *words,* as the *word-pictures* of objects, and to read these words at sight as the signs of previously-acquired ideas. These words now become intelli-

gible *objects* both of sight and of hearing, and may be treated as any other objects. They are formed of certain characters called *letters;* and now these letters, for the first time, have a significancy, as parts that make up a well-known object; and their separate forms now begin to be recognized, and may be taught, not as making up an arbitrary and unmeaning *alphabet*, but as making up *words* that represent ideas. For a like reason, *after* a knowledge of the words which they form, the *elementary sounds* of the letters may be learned, for *now*, for the first time, they are seen to form a whole or compound, which represents a previously-acquired idea.

If, therefore, we are correct in following out the principles adopted in Nature's teaching, neither the letters of the alphabet nor their elementary sounds are of any use in the primary work of teaching to recognize or call words—that is, in teaching *reading*—so far as the use of words is concerned for the mere expression of ideas. But *after* this first and primary object has been attained, and reading begins to be made one of the fine arts, and to take on the ornamental, it may receive much additional beauty, and variety, and force by elocutionary training of the ear and the voice in recognizing and uttering the elementary sounds. These exercises may, indeed, be introduced immediately *after* the words are fully learned, but should not precede them.

From the principles already deduced by observing Nature's method of teaching, it is evident that we should begin primary instruction in arithmetic, or numbers, with *objects*, and not with their arbitrary representations—with peas, beans, or other objects, or with the fingers of the hand, if you choose; but not with the arbitrary digital signs. Go as far as possible with concrete numbers—invariably associating numbers with the objects, just as Nature teaches. Children, unaided, learn much of geometry, and may be taught much more of it practically; but not by taking it up in the order of its so-called *elements*. The elementary principles of geometry are said to stand in the order of

points, lines, figures, surfaces, and solids; but who does not know that a child gains ideas of the *solid* first, and proceeds thence through surfaces, figures, and lines, to points? The merest child has obtained from Nature a very considerable knowledge of solids long before it has any other idea of a *point* than of a *material* one. Here, as in all other cases, it proceeds from the concrete to the abstract, and from the whole to the parts which compose it; just as it learns *words* first, and proceeds thence to their letters and elementary sounds.

6. The great Error in our Systems of Primary Instruction.

We believe the great error in our systems of primary instruction is the prevalent idea that we should view every subject as a completed *science*, that we should then reduce the science to its so-called *elements*, and begin our teachings with these. But this is a total inversion of the order in which every science has been built up in the growth of the race, and opposed, also, to the order of mental development, and, consequently, to the principles upon which knowledge is acquired by the individual. What we now call the *elements* of a subject are the expressions of its general truths—the final results—the few general facts or principles which science has deduced from a large collection of facts after the structure has been completed; and as neither nations nor individuals arrive at these elements first, so they should not first be presented to children. What are the *elementary sounds* of our language but the results of investigation by scholars after the language had attained its present degree of development? And yet, even scholars do not agree as to the number and character of these sounds, nor are they the same in all languages. Let us bear in mind that the *rudimentary facts* of a science are one thing, and its *elementary principles another:* the *facts* are the first things learned, and by simple perception; the *principles* are the last things learned, and they are acquired by a much more advanced mental process—that of generaliza-

tion. *Nature*, dealing only with facts, teaches the particulars, and then *we* make the generalization. Hence we see why our perceptions are right, and why our rules and principles are often wrong.

We remarked at the outset that the system of "Object" teaching is not new in principle, and that it is not only carried out in Nature's teachings, but that it is the system upon which nearly all valuable knowledge has been accumulated in the progressive civilization of the race.

7. All Science built up on the "Object" System.

All *science* has been built up upon this system; all original investigators and discoverers even now adopt its methods; it is only when we come to the elementary instruction of the school-room that we depart from its principles. Let us bring up a few cases in illustration.

If we look at the science of *botany* we shall find that it has grown from small beginnings by a close examination of the *objects* themselves. Amid the infinite diversity which the vegetable world presents, certain points of resemblance were at a very early period noticed by the most casual observers, sufficient to form the basis of some sort of a classification, even though it may have been as rude as that given by the poet Cowley when he divided the vegetable world into three great classes—herbs, flowers, and trees. But when Linnæus, and after him Jussieu, laid the foundation of the science of botany as it now exists, it was not by speculative theories formed in their closets, but by close observation of Nature herself—such a course as we have attempted to sketch the outlines of in the lessons on several of the charts in this series. Look at the "Forms of Leaves," as presented on Chart No. XIX. All these were closely examined in the natural objects themselves by the early botanists, and names given to them. Thus, different species of plants were found to vary in the general forms of their leaves, some having linear leaves, some ovate, some cordate, or heart-shaped, etc.; some species were found to have their margins entire and unbroken, others had them

variously toothed or serrate; in some species the tips of the leaves were sharp-pointed, or mucronate; in others, blunt, or truncate; and in others, notched, or emarginate; but in all the individuals of each species the family resemblance was so uniform as not to be mistaken. Yet not a step could be taken in building up the science of botany until all such particulars, and others similar to them as to the forms of the stems, flowers, roots, etc., were noticed. And if children would have the most accurate knowledge of the forms and colors, and other characteristics of individual plants, they must be led to notice the real plants themselves, or their representations. Mere description is, for the young, a very poor substitute, although it may answer, where nothing better can be had, for the mature scholar, who, having carefully observed one thing of a kind, is prepared to judge of others of the same kind by it; just as a child that has closely examined one labiate flower is prepared to judge of all other labiate flowers by that one; and when he sees a certain leaf, and is told *that* particular form is called *elliptical*, he knows the shape of any other leaf that is described as being elliptical, and of any thing else in nature that is so described. It is very apparent, therefore, that the true method of instruction is to present the *object* first, or the representation, if the object can not be obtained, and not the description. First the *idea* is to be acquired, and after that the *words* which represent it almost spontaneously follow.

This is as true, both of the method of discovery, and of all approved subsequent study, in all other sciences as in botany. Not only did the discoverers in anatomy examine every bone, and nerve, and muscle, and vein, and artery, and notice their varied uses, and their conditions of health and disease, but we think it necessary that students in anatomy at this day should pursue the same course of instruction. Does not the geologist examine the rocks themselves; the astronomer turn his telescope to the heavens, that he may see with his own eyes; the chemist go over in his laboratory the experiments of his predecessors; and the

scientific farmer study the conditions of vegetable growth in the analysis of soils and plants, and in experiments based on what he thus learns? And if "seeing is believing," and leads older students in the most direct road to knowledge, does not the same principle hold good with children; and ought we not, as far as possible, to pursue the same system in their education? Let them learn by the evidence of their own senses as far as they can, for then they will be apt to learn aright. In the knowledge thus acquired they are always interested. To *see* is to know, but that which is merely *told* is often unheeded, misapprehended, or disbelieved. We see, therefore, that Nature teaches, and that science progresses, from the observation of the rudimentary facts, upward to the rules and principles which are the generalization of them. And why should we, in our school instruction, invert the order?

8. Why Science is adapted to Childhood.

It is easy to see that, when presented in the true inductive order, all the natural sciences, which are built up of *facts* from the great book of Nature, are peculiarly adapted to the capacities of childhood—giving constant activity, as they do, to the perceptive faculties, and storing the mind with materials for the further exercise of memory, comparison, association, imagination, reason, and judgment. Many subjects which are put far advanced, even in the curriculum of college studies, by reason of the *inverse* order in which they are presented in books, are thus seen to be connected with the common matter of every-day life, and their rudimentary facts to be constantly passing under the observation of children. A little pebble is a very common matter, which children often handle with little interest; but connect it with the geological history of our earth—show how, in some deep and quiet sea of a bygone age, it was slowly deposited, particle by particle, and finally became hardened into stone—show the strange animals and plants that were its contemporaries—how it was subsequently broken from its rocky bed; and after being tossed and buffeted by the

waves for ages longer, until, worn into its present form, it was left where you chanced to find it—and it at once becomes an object of curious regard in the eyes of the intelligent child; for in its little self it presents the records of a history wonderful and grand in the extreme. Thus every pebble from the brook, every shell from the sea-shore, every plant from the fields or wayside, and every star that twinkles in the evening sky, becomes a rudimentary fact of scientific knowledge—a fact which even *children* can comprehend. What we need is to present such facts (and there is a boundless store of them ready at our hands) in their appropriate order, in a system of primary instruction. Let our reading-books prepare the way for this system, both for teachers and pupils, by giving *to all* some little insight into the mysteries contained in the great volume of Nature, which, unhappily is yet a sealed book to many of our educators themselves; and then let the system of "Object" teaching, now being inaugurated, work out the details.

9. Why "Grammar" is not adapted to Childhood.*

Perhaps in no branch of education do we violate nature more than in the manner in which we presume to teach *children* "the art of speaking and writing the English language with propriety;" or, as it is called, *English Grammar*. Language grows up with the child as a *habit;* he uses the same words and forms of expression that are used by those with whom he is brought most in contact; he imitates them, whether they speak correctly or incorrectly, and one form of expression is just as natural to him as another, and just as correct, after he has formed the habit of using it. His *ear* is the medium of all the instruction in language which he receives in a course of natural training; and *his* language grows up, just as language has grown up in the progress of the race. If the language to which he has been accustomed has been correct, he needs no farther

* By "Grammar," as will be seen, we do not mean the study and practice of *language*, but the study of the *philosophy* of language.

instruction to teach him to speak correctly; if it has been wrong, he needs to be told what forms he should use, and, in addition, as all the forms of language are arbitrary, and as he has learned to use them by habit, he needs some kind of training that shall form *other* habits. But, in the ordinary mode of teaching, the child is set to learning those principles which unfold the philosophical *construction* of the language—such as what the subject or nominative is, what the predicate or verb, and object—qualities, attributes, connectives, disjunctives, etc.; and then the *rules* of syntax, in accordance with which the different parts of this arbitrary system are hinged together. But all this is a very roundabout method for leading to the substitution of one arbitrary form for another. Now the expression "I is" is just as good, primarily, as "I am;" but if we would have the child change the former for the latter form, is it necessary first to construct an elaborate science, then from the science deduce the rule that "a verb must agree with its nominative in number and person," and then have the child learn the *rule* in accordance with which the expression shall be corrected? But even when the child *has* learned the rule, can he correct the expression any better by its aid? Does he see why "I" and "am" agree any better than "I" and "is?" why the former expression is correct, and the latter wrong? Nature has built up the language, not in accordance with arbitrary *rules*, but in accordance with *usages* which have grown into habits. Language knows no other law.

It would seem, therefore, that if a child speaks incorrectly we should better secure the desired change by direct correction than by rules; for the rules, in addition to the long road it takes to reach them, are just as arbitrary as the simple correction, and much more difficult of comprehension by children. And why should children be expected to learn to speak by rule a language that was never formed by rule? The rules are the final deductions of the science of language; and though they are said to embrace its *elementary principles*, they are not what either individuals or nations first learn in the acquisition of a language.

What we have said here on the subject of instruction in language has reference to primary education only—to the simple matter of the *art* of speaking and writing correctly, which, however, the ordinary study of grammar seldom attains to—and not to the course which may be pursued by scholars who wish to make themselves acquainted with the *philosophy* of language.

As some confirmation of our views on this subject—if they need any other support than is to be found in the facts already presented—we would refer to Herbert Spencer, who gives very satisfactory reasons, upon general principles, for denouncing what he calls "that intensely stupid custom, the teaching of grammar to *children*." M. Marcel says: "It may without hesitation be affirmed that grammar is not the stepping-stone, but the finishing instrument." Mr. Wyse argues: "Grammar and syntax are a collection of laws and rules. Rules are gathered from practice; they are the results of instruction, to which we come by long observation and comparison of facts. It is, in fine, the science, the philosophy of language. In following the process of nature, neither individuals nor nations arrive at the science *first*. A language is spoken, and poetry written, many years before either a grammar or prosody is even thought of. Men did not wait till Aristotle had constructed his logic, to reason. In short, as grammar was made after language, so ought it to be taught after language."

10. How Language is to be taught.

But how, it will be asked, shall we teach language? We reply, just as Nature teaches it. Cultivate the perceptive faculties (to which "object" teaching is specially adapted) to their greatest extent, so that they may supply the mind with the greatest possible number of valuable and clearly-conceived ideas—the materials of knowledge, as well as the soul of all language. The faculty or power of speech is then to be exercised in accordance with those forms of language which custom prescribes; and, like all other faculties, *exercise* alone can give it proper cultiva-

tion.* The only difficulty that intervenes is where wrong habits of speech have already been formed by violations of the natural law of usage. The wrong habits need to be corrected; but this is not a legitimate part of education, any more than the giving of medicine for violations of Nature's laws is a part of the economy of Nature. We do not think the natural and direct remedy is to be found in studying the *philosophy* or grammar of the language, but in the supplanting of the bad *habits* of speech by correct ones, and in the same manner that any other habits are formed. The following is the *remedy* which has been found most successful in our own experience.

11. Correction of bad Habits of Speech.

We once had charge of a large school of boys, nearly all of whom had formed such habits of speech that, in their ordinary conversation and in recitations, there was an almost constant violation of grammar and good usage; and although their faulty expressions were often corrected, and they knew them when pointed out, yet inveterate habit ruled in spite of all our efforts. We then supplied every pupil with a pocket blank-book and pencil, and required him to write down every wrong (ungrammatical) expression which he detected himself in using, or which he heard from his associates; and a few minutes daily were devoted to reading and commenting upon these expressions. In a short time the most obvious faults disappeared from the school-room and play-grounds. We closely watched the operations of the system. We soon observed, when a question was asked or answer given improperly in the school-room, that, although the pupils at their desks seemed to be absorbed in their studies, they would detect the faulty expression sooner than any thing else, and pencils would be busy in minuting it down. In fine, we observed that the *ears* of the pupils were being rapidly trained to detect these faults, just as the ears of the musician become

* See the exercises in speaking and writing ("Composition") which accompany the use of the charts.

trained to detect discords in music; and we found that when this was fully accomplished, the evil was corrected. We were satisfied that one month's time of this kind of training was worth more to our youthful pupils in acquiring the *art* of speaking correctly than two years devoted to studying the rules and principles of grammar.

We adopted the same general plan with those advanced students who were studying the *philosophy* of the language from the grammatical text-book, for we observed that the *rules* of correct speech had very little influence in forming in them correct *habits* of speaking, just as we know some teachers who pride themselves upon teaching English grammar, but who are continually murdering the "King's English" in their ordinary conversation. We required our students—young men—to write down not only the *ungrammatical* expressions which they detected themselves, their classmates, and their teachers in using, and which they heard in sermons, lectures, etc., and found in standard books, but also such forms of expression as were rhetorically or philosophically defective—a large and important class, not covered by the ordinary rules of grammar. These formed the subjects of our most interesting and most important lessons in language. We found that such exercises, by training the ear and the eye to detect what had before often passed unnoticed, were the only effective means, where wrong habits had been previously formed, of making *practical* grammarians.

12. The "Natural Order," the first great Law of Development.

Our observations have thus far had reference chiefly to the principles of mental development, and the consequent natural order in which subjects should be presented to the minds of children; and we have illustrated our views by a few specifications. We may conclude, therefore, that this Natural Order of the presentation of subjects is the first great law of mental development, and that we may expect to be successful in our systems of education only so far as

we adhere to the principles which the Great Teacher has developed in the laws of mind itself. We also infer that, as all the materials of knowledge are derived through the perceptive faculties, primary education should be directed chiefly to *their* culture, in accordance with the laws of their action: and if the rules, principles, and generalizations of science can not be comprehended by the mind until the perceptive faculties have supplied the rudimentary facts on which they are based, then we should not begin our teaching of a science with these generalizations. But all *rules* are generalizations. We should, then, discard rules until they are developed naturally from the accumulated perceptions. We also infer that as Nature never gives children *words* until she has given them *ideas* which require expression, so we should be careful in our teaching not to invert the order—not to teach the signs or sounds before we impart ideas of the thing signified. And if Nature gives perceptions of an object *as a whole* before it notices the parts which compose it, we should adopt the same order of presentation; and if ideas of things concrete (as "a foolish man," "three apples") precede those of things abstract (as "folly," "three," etc.), we should learn a principle of education therefrom. It is on such principles of mental philosophy that the "object" system, or true *development* system of teaching is based.

13. "Exercise," the second great Law of Development.

But there is still another fundamental principle of education, to which we have yet scarcely alluded, but which is quite as important as the *order* of mental development and the *order of presentation* of subjects. It is this, that Exercise is the great law of man's threefold nature—mental, moral, and physical—and that without it there can be no development. *Plants*, attached to the soil, incapable of voluntary motion, and hence needing none, require for their perfect development only such suitable nourishment as nature provides; but *animals* require, in addition, the *exercise* of all their powers and faculties; and without it they

never come to maturity, and when it is withdrawn even the physical nature languishes, all the faculties become enfeebled, and the animal soon dies. But while exercise is every where acknowledged to be absolutely essential to man's physical development, its importance in a specific training of the *senses*, as well as of the higher mental powers, has not been fully appreciated; and still less has it received its due consideration in *moral* culture.* And in still another wide field—in the exercise of the *constructive* energies of children for the purpose of giving regulated culture to the natural craving for invention and design—education has made no advances. A few suggestions on this subject will be found elsewhere in this volume.†

14. What the true Development System aims at.

The true *development* system, of which "object" teaching is only a part, is designed, in addition to its proper presentation of the materials of knowledge, to mark out such a course of training for the young, that all the faculties shall receive exercise of such an amount, kind, and quality as shall best conduce to the harmonious and complete development of the whole individual. The lessons throughout this volume will best show our views of the manner in which this may be accomplished, so far as they cover the ground of primary education. There are, however, additional subjects happily adapted to this kind of elementary training—such as may be found in the boundless variety of the insect world and in the mineral kingdom—which are scarcely alluded to here, but which we hope to present hereafter in additions to the present volume, and in connection with additional charts, and the completed series of the "School and Family Readers." It is not to be supposed that all the objects aimed at in this *development* or "object" system have yet been fully attained; for not only is the system yet in its infancy, but no serious attempt

* See remarks and directions on this subject in Calkins's "Manual of Object Lessons."

† See remarks under the head of "Geometrical Drawing," page 54.

has heretofore been made to reduce it to "working order," and to adapt it to the practical duties of the school-room. Defects in any complete course of primary instruction that can now be presented will doubtless be found; but if the principles of the system are correct, the experience of teachers will soon suggest the proper corrections.

15. No Danger of carrying the System too far.

Apprehensions have been expressed in different quarters that this "object" system, or *development* system, may be carried too far. The fear, we imagine, has been on the part of those who do not understand its true principles. There can be little danger of its being carried too far, if it be what we have described it, and what teachers should make of it—a presentation of *facts* to the mind, in their natural order, and not of rules and theories. Who will maintain that children are likely to see and hear too much, and that the voluntary exercise of their perceptive faculties is likely to be attended with any injury? When we send children into the fields for recreation, we do not bandage their eyes nor close their ears, lest they may see too much of the myriad forms, shades, and colors of Nature, and their ears be too much ravished with its music; but we think that all the delights which they can thus enjoy will make them both wiser and better. Seeing and hearing much do, indeed, cause children to ask questions almost innumerable, because it gives them a craving for knowledge; and we wish we could say that parents and teachers have now more correct views of education than to check this inquisitiveness. Knowledge acquired under the stimulus of childish curiosity is very different from lessons poured into an unwilling ear. Those who will look through the sample lessons and exercises in this volume will see that they do not consist in *telling* about "common things," but in so presenting facts as to awaken the perceptive faculties to voluntary and pleasurable activity, for the purpose of *developing thought*. In accordance with the true development system, instruction about common things—that is,

telling about them—should come in only incidentally, and after the awakening of a curiosity that thus seeks gratification. Seek, therefore, by every proper means, to awaken this curiosity in children, by the presentation of the natural objects or by the best pictorial representations of them, by oral descriptions, by anecdote and incident, by poetic allusions, and by such every-day reading lessons as shall embrace a wider range of utility than the merely ornamental part of the art of reading—the mere calling of *words* in an elocutionary manner.

We would remark here that the following exercises, accompanying a description of the charts, are not intended to be followed out, necessarily, in the exact order in which they are here presented, which is in the order in which the charts are numbered; for several of the charts will often be needed for daily exercises upon different subjects. The teacher must often arrange his own programme of *grades* and *steps* in object teaching, which will be regulated by the amount of time which he can devote to each subject; but we would advise him to take as his guide, for early training, the Programme laid down by Mr. Calkins in his "Manual of Object Lessons;" and for a more extended course we would refer to the "Approximate Programme" found in the Appendix to this volume.

We would refer to the article on Drawing, as illustrated by Chart No. X., for some important principles in that department; to the remarks on Geography, in connection with Chart No. XI., for an exposition of the true development system; while the article on Colors, as illustrated by the chromatic scale on Chart No. XIV., we believe to be the most *practical* exhibition of that subject that has ever been presented.

AN EXPLANATION OF THE

SCHOOL AND FAMILY CHARTS,

WITH SUGGESTIONS OF PRINCIPLES AND METHODS OF DEVELOPMENT, AND INFORMATION FOR THE TEACHER.

DESIGNED FOR AN EXTENDED COURSE OF ELEMENTARY INSTRUCTION, AND ADAPTED TO THE SYSTEM OF

OBJECT TEACHING.

WHILE the charts, in connection with the present manual, are designed to carry out in a natural order the true *development* or "object" system of instruction, beginning with the very earliest scholastic training of children, they also embrace, as a part of that early training, the teaching of the ALPHABET, of READING, of SPELLING, of PRINTING and DRAWING, of WRITING, and of ORAL COMPOSITION. The first principles of NUMBERS and of GEOGRAPHY are also illustrated here, in accordance with the object system; and if we have succeeded in our purposes, we have presented in the earlier numbers of the charts, with the accompanying directions, a complete programme of such a course of *elementary* instruction as is required for the younger pupils in our schools. In what manner these subjects, as well as those more advanced, are made parts of the object system, will be fully developed as we proceed with an explanation of the charts and their varied uses. Moreover, the INFORMATION here embodied, as explanatory of the Natural History Charts—and especially in the departments of zoology and botany—is designed as the carrying out of the PLAN of the "School and Family Readers," by furnishing such *additional* valuable information in the Natural History departments as was much needed, and such as the Readers, from their necessarily elocutional character, could not fully embrace. It will now be seen, also, that the series of "School and Family

Readers," the "Primary Object Lessons," the "Manual" by Mr. Calkins, with the present work (which harmonizes with it), and the "School and Family Charts," are intimately connected in their design, principles, and plan, as parts of *one* system; and we believe that these several parts will now be found combined into one harmonious whole.

CHART No. I. ELEMENTARY.

Here are sixty words, each illustrated, and they contain all the letters of the alphabet. We suppose the child, when this chart is first presented to it, not to know its letters nor any thing about reading. The child has, however, from Nature's teachings, already learned to distinguish a *great many objects*, and to call them by their appropriate names. Indeed, most of the objects represented on this Chart it is probably already familiar with, either from actually seeing the objects themselves or their pictures. The child has, therefore, already learned to recognize the *objects*, to recognize their *pictured* representations, and to designate them by their appropriate *names*. It has proceeded in the natural order of, 1st, the *idea*, and 2d, the *word* to express it. Let the teacher pursue the same order—ideas before words—and the child will soon learn to *read* as naturally as it *talks*.

Words taught as the Representatives of Things.

As the child talks—that is, calls the *names* of things, and utters sentences—before it knows its letters or learns how to spell, so it will be found that the most natural order is to read *words* by sight before it learns how to spell them, or even to *name* their letters. Thus, the child sees an animal, and before it can tell all its parts, or, indeed, name any of them, it learns to distinguish it *as a whole*, and to call it "*dog*." In the same manner it will easily learn a word *as a whole*, and *name* it, before it can readily distinguish and name its several parts.

Therefore let the teacher, in commencing his course of instruction at this point, and having, if possible, a *class* of beginners before him, point to the picture of a cap on the Chart, and ask what it is. Some pupil will probably say, "It is a cap." Teacher holds up a cap, and asks what *that* is. Pupils now observe the difference between the two, and say that one is a *real* cap, and the other the *picture* of a cap. Tell them that pictures represent things or objects, and that many *words* also represent objects. Ask them what *word* represents a dog. Ask them if they would like to see the *word* which represents a *cap*. Point it out to them; tell them to see how it looks; ask them if they would know it if they should see it again. Ask them if they can find it on Chart No. II. The class find *four* such words on Chart No. II. Let them find the same on Chart No. III., and tell *which line* it is in. Call attention to the number indicating the line.

In a series of lessons let them go through a similar course with all the other words on Chart No. I., and find the same words either on Chart No. II. or No. III. In Chart No. III. let them tell *which line* each word is found in. In this way they learn, additionally, to count, and to recognize numbers up to 17.*

* On this Chart *seven* of the illustrations—those connected with the words *cage*, *arm*, *swan*, *nest*, *pig*, *kite*, and *ox*—represent *more* objects than the words. This may be thought an objection by some; and if it shall be found so, we purpose to change them. We suggest, however, the following advantages from retaining a *sufficient number* of such complex illustrations to break the uniformity of the others.

When the child comes to the illustration connected with the word *cage*, ask it what the picture represents. The child will perhaps say, "A girl, a cage, and a bird." Tell the child that *one* word can represent only *one* thing (or one collection of things, as leaf, leaves); and that the word here given represents the *cage*. This explanation arrests the attention, fixes in the mind of the child the particular thing represented, and leads it to examine the pictures more closely; so that when it comes to the third picture below, it notices there *several* objects, and wishes to know *which* of them the word represents.

As each word on the Chart is learned primarily by associating it with its picture, perhaps the object in view will be as readily attained in the

Calling Words at Sight.

Teacher places a strip of paper over the cuts in one column at a time, and, pointing out the words, at first in regular order, and afterward promiscuously, requires the pupils to name them. This is continued until all the words can be readily called at sight.

The Alphabet, Counting, and Printing.

Teacher points to the word *cap*, and asks how many *parts* there are in that word. If the pupils can *count* a little, they say *three*. He tells them those three things are called *letters*. He points out other words, and requires them to tell him how many letters each contains. While they are thus learning to count, go back to the word cap, ask them to notice the shape of each letter in it, and tell them their names. After requiring them to examine attentively the first letter, C, and to notice and describe its form, he asks them, one by one, to point out and *count* the Cs in the first column (6), in the second (none), in the third (none), in the fourth (2).

After the lesson, let them draw (print) the letter C on their slates, and let some of them draw the same on the blackboard.* It is very important that, in these first at-

case of the complex as the simple illustrations, while, additionally, closer observation and discrimination will be called forth in the former instance.

If it should be found that the attention of the children is too much diverted from the particular object and its name by the surrounding pictures, take a large newspaper, cut a hole in it of the size of the objects to which you wish to confine their attention, and cover up the rest of the Chart.

* It may be objected that *drawing* should begin with *straight* lines in various positions, to be followed by curved lines in various positions, and that only after *such* elementary lessons should the pupil be allowed to combine them into the forms of letters. We think it would be just as reasonable to require the infant to move its hand through a series of exercises in straight lines, and then through another series in curved lines, before it should be allowed to combine them in the graceful motions which Nature teaches. If the drawing in straight lines, or motion in

tempts at drawing or writing, the pupils should have a *long pencil*, and that they should hold it *just as they should hold a pen in writing*. The *habit* of holding the pencil or pen properly can be easily formed at this period; whereas the habit of holding it in an improper manner can be corrected only with the greatest difficulty. Let the class go through with A and P in a similar manner.

When they come to the second word, CAT, they find they are already familiar with two of the letters, and they learn T as they learned the others. They thus continue until not only all the words on the Chart, but all the letters of the alphabet are familiar to them. They should count the number of letters of each kind on the Chart.* Also the number of pictures, or words, in each column; then on the whole chart.

In making *drawings* of the letters on their slates, and on the blackboard, they will for a time make very awkward figures; and not until they have acquired a considerable degree of control over the muscles of their fingers will they be able to form much of an imitation of the originals. Their very failures, however, will not be without advant-

straight lines, could be shown to be any easier or more natural than curvilinear motions, there might be some show of reason for restricting the pupil to the tedium of strictly angular movements; but we see no reason why both classes of motions may not be carried on simultaneously in drawing, the same as in nature. Why, for example, confine the child for days and weeks to the monotonous exercise of forming the straight perpendicular line of the letter P, before it is allowed to try its skill upon the circular part of the letter? Will it not be likely to succeed quite as soon in forming the entire letter, when it is allowed the pleasure of alternating the exercises? What is needed is care in forming each part; and this, we think, will soonest be acquired when the pupil can see the relation of each part to the whole. Moreover, the child sees no reason in making a long series of straight lines, and wearies of them; but let him see how straight and curved lines are needed to form letters, and he will be interested in making them as accurate as possible.

* The letter A is found on this Chart 20 times; B, 8; C, 8; D, 8; E, 27; F, 5; G, 10; H, 9; I, 12; J, 1; K, 5; L, 10; M, 6; N, 9; O, 26; P, 6; Q, 1; R, 12; S, 14; T, 8; U, 8; V, 2; W, 7; X, 3; Y, 3; Z, 1=229 letters.

age to them. When they have acquired some degree of steadiness, draw parallel horizontal lines on the blackboard, and let them draw the letters between them, as a guide. Then let the pupils draw similar lines.

While this series of drawing exercises is progressing from day to day, the exercises on Chart No. II. should be taken up; for the more familiar pupils become with the words, the easier will they learn the letters which compose them. They thus learn the letters after they know their *uses*, which is much better than the old, arbitrary, and tedious method formerly practiced.

The pupils will thus have learned, from this Chart, to CALL WORDS AT SIGHT, as they tell the names of familiar objects; to NAME THE LETTERS OF THE ALPHABET; to COUNT; and to make a beginning in DRAWING or writing. In the mean time they may have received some exercises on Chart No. II., to which we now proceed.

CHART No. II. READING: FIRST LESSONS.

This Chart embraces the First Series of Lessons in Reading, which is here arranged in six progressive Divisions.

First Division of the Chart.

Reading.—1. Teacher points to the word *cap*, and asks the pupils to name it. They say "*Cap.*" He points to the word *cat*, and they name that also. He tells them the word between these two is *and*, and then asks them to read the *line* (or *phrase*), which they now readily do. They then, by the aid of the pictures, easily read all the lines or phrases in the first division.

2. Cover the pictures by a strip of paper, and require them to read without their aid.

3. Also cover the words, and let them form the phrases by the aid of the pictures.

Oral Composition.—4. Turn back to Chart No. I., and require the pupils to form the words there, two by two,

into similar phrases, connecting them by *and*, and repeating them aloud — omitting, of course, the adjectives red, blue, pink, etc. Thus, "face and cage," "quail and snail," "arm and chair," etc.

Spelling.—5. They may now name the *letters* in the words on Chart No. I., and pronounce the words, still having the Chart before them.

6. When they can thus spell out the words with considerable facility, cover the *words*, and, letting them see the *pictured* representations only, require them to name the *letters* from memory, and tell what words they form.

7. It would now be well for the pupils to be supplied with Type Letter-cards, each card containing, on each side, the same letter of the alphabet. If they have these, place before them a large number of these cards, and, allowing them to look at the Chart, let them select and arrange these cards on the table, desk, or *frame*, prepared for the purpose, so as to form the words on Chart No. I.*

8. Next, cover the *words* on the Chart, and let the pupils form them with the cards, by the aid of the pictures only.

9. Let them spell out the words, and form the phrases, in the first division of Chart No. II., in a similar manner; first looking at the pictures and words, and, secondly, having the words covered.

Printing and Drawing.—10. Let the pupils print the words in this division on their slates, and on the blackboard, being careful to use a long pencil, and to hold it as they should hold a pen. This should be done, not as a task, but as a recreation; and if the pupils should occasionally leave this exercise for rude attempts at picturing animals,

* A "Composing-frame" has been prepared for the purpose of holding the Type Letter-cards, which latter are to be arranged by the pupil so as to form words and sentences. A box of the accompanying Letter-cards contains not only the capitals and small letters, but also the marks of punctuation, accents, inflections, etc., and all made of their proper relative height and width, to correspond with *type* of the same size of font. The pupils will find the use of these Letter-cards and Frame an agreeable pastime, and the most practically useful and interesting of all spelling exercises.

or any other appropriate objects, they should be allowed to do so without censure. Let them draw on their slates as much as they choose. Give them Chart No. X. to copy from, in accordance with the directions, p. 52–3.

Counting.—11. Let the pupils, during the preceding exercises, count the letters in each word; then in each line; and, finally, in the whole division.

Second Division of the Chart.

Reading.—1. The pupils will easily read these phrases, as the words and pictures are already familiar to them.

2. Cover the pictures, and let them read the words.

3. Cover the words, and let them form the phrases by the aid of the pictures.

Oral Composition.—4. Turn back to Chart No. I., and let the pupils, in a series of exercises, give to each noun there some descriptive term; thus forming phrases similar to those in the Second Division of Chart No. II. Also let them give to each noun as many descriptive terms as they can; as, a *red* cap, a *blue* cap, a *white* cap, a *black* cap, an *old* cap, a *new* cap, a *dirty* cap, a *soldier's* cap, a *night*-cap, etc.

Spelling.—5. Let the pupils name the letters, and pronounce the words in this division, being careful to avoid a monotonous or drawling tone.

6. Let them do the same when the words are covered.

7. Let them, while looking at the Chart, use the cards in forming the same phrases.

8. Let them do the same from memory, with the words covered.

Printing and Drawing.—9. Let the pupils print the words, and form the phrases in this division on their slates, and on the blackboard. Let them hold the pencil properly. Use Chart No. X., according to directions, p. 52–3.

Counting.—Let the pupils count the letters in each word, each line, and in the whole division, as before.

Third and Fourth Divisions.

Divisions Three and Four should be gone through with

in a manner similar to the Second Division. The few new words will now be easily learned.

Fifth Division.

Here are the first *complete sentences* that we have presented, and they are given without illustrations.

Reading.—These exercises may be similar to the preceding. Let the pupils also name the words when pointed out to them promiscuously. This will show whether they recollect the word from its *form*, or from its position in the sentence.

Oral Composition.—Let the pupils form similar declarative sentences with the verb *to be* (is and are), using, as the *subjects*, the nouns given on Chart No. I. Thus: "The cat is tame." "The bat is quiet;" or, "is sitting," etc. "Those lambs are tame." "That cat is cunning," etc. This will exercise their ingenuity, and, while it will form a pleasant recreation, it will give them some ideas of writing compositions.

Spelling.—This should now be done chiefly by the aid of the Type Letter-cards (if the school has them); first forming the sentences in this Fifth Division, and afterward others similar to them. Spelling them aloud may also be practiced.

Printing and Drawing.—Let the pupils print the sentences in this division on their slates, and on the blackboard —using a long pencil, and holding it as a pen.

Let them print as many of the new sentences, similar to them, as they can. Directions for *Drawing*, see p. 52–3.

Counting.—The same as in the former divisions.

Sixth Division.

Reading.—As only two new words, "pet" and "new," are found in this division, the pupils will have little difficulty in reading all the sentences.

Let them also name the words when pointed out to them promiscuously.

Oral Composition.—1. Let the pupils, by referring to

Chart No. I., form as many sentences as they can similar to those in this Sixth Division, giving to each noun used *two* descriptive terms or adjectives. As, An old blue cap. A new wire cage. A large ripe pear. A pretty pink chair. A large iron box. A poor little fly, etc.

2. Also let them separate the descriptive terms. Thus: A large and shaggy dog. A large and gentle ox. A fresh and pretty rose. A tall and lean hound. A sly and cunning fox. A fierce and roaring lion, etc.

3. Let them use the verb *to be* with these latter exercises. Thus: The dog is large and shaggy. The rose is fresh and pretty, etc. These may be found rather difficult exercises for pupils at this stage of their progress, as it may not be easy for them to find *two* descriptive terms which they can use with each noun; but if they accomplish only a little with these exercises, that little will be valuable to them, and probably all that their capacities require.

When they have carried these exercises from Chart No. I. sufficiently far, let them form similar sentences with nouns of their own selection.

Spelling.—The cards should be used to form, first, the sentences in the Sixth Division, and afterward others similar to them. The words may also be spelled aloud.

Printing and Drawing.—The same as in the Fifth Division.

Counting.—The same as in the former divisions. Also let them now count two divisions consecutively; then three, four, five, and finally all the letters on the Chart.

CHART No. III. READING: SECOND LESSONS.

Reading.—This Chart contains all the words on the first Chart, and is designed to be used chiefly in connection with the first, as before explained, for the purpose of testing the knowledge which pupils have of the *words* when seen apart from the illustrations.

The pupils should also use this Chart for separate read-

ing exercises until they become perfectly familiar with all the words. The teacher should be careful that the pupils do not let their voices fall at the *commas*. The voice receives the rising inflection at the commas, and the falling at the period. Here are presented the first *capital* letters, which will now be gradually learned from this and the following Charts, without calling special attention to them. The exercises here are *numbered* from 1 to 17 inclusive. Let the pupils learn the meaning of these figures. They have already learned to *count*, and should now begin to make an application of the *figures*.

Oral Composition.—1. Let each pupil take line No. 1, and connect an adjective, or some other descriptive word or words, with each noun, repeating the same aloud. Thus, "A blue cap, an old cat, a long-eared bat, two tame lambs, and a gray rat."

Let them go through with the entire Chart in this manner.

2. Let each pupil take the words in the first line, and form them into clauses like the following, repeating them aloud, and connect the whole in one general sentence. Thus: "A cap for the boy, a cat to catch mice, a bat in the air, some lambs in the field, and a rat in his hole." "The arm of a man, a chair for the parlor, a ripe pear on the tree, and the claw of an eagle," etc.

Let them go through with the entire Chart in this manner. This will exercise the ingenuity of the pupils, and call forth a proper spirit of emulation.

Spelling.—The type-cards should now be used to form, first, the sentences on the chart, and then, as indicated above, others formed by the pupils. This will require them to use some of the *capital* letters, and also to spell *some new words*. If they are at first unable to spell these words, they may go for assistance to the teacher, who should print them on the blackboard, or let some older pupil do it. The pupils will then be able to form these words with their cards, while the very difficulties which they have encountered will lead them to observe words more closely,

and to see the importance of being able to spell them. They may also spell the words aloud.

Printing and Drawing.—While some are setting up the sentences with the type-cards, others should print them on their slates or on the blackboard. Do not forget to require them to hold the pencil properly. In these exercises be careful to use the *figures* where they can be properly used to *number* the exercises.

Counting, Adding, and the Use of Figures.—The pupil is now supposed to be able to *count*, perhaps as far as a hundred. He has also learned something of the use of *figures* to designate numbers. To extend this knowledge farther, let the pupil set up with the Type Letter-cards, or print on the blackboard, the first lesson of Chart No. II., "Cap and Cat." Let him count the letters in the line, and place the number, 9, at the end of it. Let him also put the number of letters in each word under the word, and at the right the whole number, 9. Teach him that three letters and three letters more make six letters, and that six letters and three letters make nine letters.

Let him continue these exercises throughout both Chart No. II. and Chart No. III. He will thus, with the little assistance which he will now be likely to obtain *at home*, soon learn to count and to add with considerable facility; for when children are once put in the way of counting things, they are apt to *teach themselves* fast enough. All these exercises in numbers may be carried on in connection with or supplementary to the counting and adding of beans, pebbles, or other real objects, as indicated in the instructions given in Calkins' Primary Object Lessons, beginning with page 138.

In such exercises the pupil should not be *kept back* for the sake of going through any regular *system*. The teacher must exercise his own judgment in this matter, and adapt his instructions to the capacities of his pupils.

CHART No. IV. READING: THIRD LESSONS.

[In connection with the exercises on this Chart, the pupils may take up the early Reading Lessons in the Primer, or First Reader. They may also begin with the exercises on Chart No. VII., Elementary Sounds, see page 43.]

In the third series of Reading Lessons we enter upon more extended and complete sentences, which present the first exercises in *elocution* proper. For the principles of the *inflections* here presented, and the importance of early attention to them, we refer to the "Directions to the Teacher," "Prefaces," etc., together with Reading Lessons, in the Primer and First and Second Readers of the "School and Family Series."

Reading.—Here are fifteen *subjects*, presented by fifteen illustrations, with a short reading lesson on each.

1. Let a pupil try to read the first lesson. If he fails in any of the words, let another try. If none can do it, the teacher should tell them the new words, and then have them read the line, and at the same time point out each word in it. They may also point out and name the words backward. (The teacher may find it desirable to cover up all the lines or lessons below the one which the pupils are reading.)

2. Let them go through all the fifteen lessons in a similar manner.

3. As soon as they know all the words in a line, the teacher should read the line *elocutionally*, giving the proper inflections, emphasis, etc., and should require the pupils to imitate him. Notice that the words printed in *italics* are to be pronounced with more emphasis than the others. Let the teacher illustrate the rising and falling inflections by a variety of examples, and have the pupils imitate him.*

* The teacher should make himself perfectly familiar with Rules I. and II., page 8, and Rules III. and IV., page 22, of the Second Reader, together with the abundant illustrations that are given. He may gradually explain these rules to the pupils in simple language, so that they may begin to apply the inflections to their own compositions, especially in the *two kinds* of questions.

4. Let each pupil read all the lessons consecutively, being careful to give the inflections and emphasis properly, and avoiding the least appearance of monotony or a drawling tone.

Oral Composition and Writing.—1. Call upon a pupil to *tell* something about the Picture No. 1 (the subject) different from the lesson given. Thus, "Three boys are running after the dog and the pig." Teacher, or some older pupil, may print the same on the blackboard. Another pupil may also tell something about it; and if his imagination should help him a little, his "composition" will probably be the better for it. He examines the picture closely, and makes up a composition something like the following: "The pig's mouth is open. The dog holds the pig by the ear, and makes the pig squeal." Teacher, or some older pupil, prints this on the blackboard. Call the attention of the pupils to the *pauses* used. Tell them when the period is used, when the comma, etc.; the apostrophe also, if it should be used.

2. Next take the second picture, and let the pupils form compositions from that as the subject. Encourage them to put some *questions* into their compositions, like those in the reading lesson. Thus: "Ann is feeding the hens. There are two hens and a rooster. Why does not the *rooster* eat\`? What is Ann feeding the hens with\`? Is it corn′? She carries the corn in her apron," etc. Encourage the pupils to *notice* and *tell* as many things about Ann, the engravings, etc., as they can. As, for example: "Ann has no bonnet on. She has long curly hair, and a short dress," etc. These may be printed on the board, or set up with the Type Letter-cards, with the proper pauses, inflections, interrogations, etc., which should be explained to the pupils.

3. In a similar manner, all the illustrations should be taken up as subjects for compositions.

4. The teacher may also call the attention of pupils to real objects, in the school-room or elsewhere, and require them to notice them carefully, and make up verbal compositions about them, stating as many things or facts about

them as they can. As soon as the pupils have learned to form the script letters, Chart No. IX., they may write out some of these compositions. See directions for script writing, page 50.

Spelling.—1. A use of the Type Letter-cards, as before directed, in setting up, not only the lessons given on the Chart, but also such compositions as the pupils may form, will furnish a very valuable course of spelling exercises. If they fail in setting up the new words correctly, aid them.

2. The teacher may also have them spell aloud both the words on the Chart, and the new words used.

Printing and Drawing.—Let the pupils print (or *write*, if they have yet learned the script letters, Chart No. IX.) the lessons of this Chart on their slates, and on the blackboard, putting in the *numbers* (figures) for the lessons, and paying particular attention to the *capital* letters. They should be told *when* to use the capitals. The pupils may, very likely, undertake to make drawings of some of the illustrations given here. They should be *allowed* to do so, but without much special encouragement yet. It is supposed that they are now acquiring some facility in making *letters;* and when they can make these pretty well, they will be all the better prepared for *picture* or *object* drawing. In all their marking, or picture-making, it is important that they should use a long pencil, and hold it as they should hold a pen.

Numbers.—In setting up a line with the Type Letter-cards, or in printing it, they may put the figures denoting the number of letters in a line at the end of the line; also the number in each word under the word. They may next add the figures aloud, and see if they can make their sum equal the number which they obtained in *counting* the letters. The teacher should vary these exercises as the capacities of his pupils require.

CHART No. V. READING: FOURTH LESSONS.

[**The Reading Lessons in the Primer, or First Reader, should be continued in connection with the exercises on this Chart. Also the exercises on Elementary Sounds, Chart No. VII. See page 43.**]

The reading lessons in this Fourth Series are somewhat more full than those of the preceding Chart, but they introduce no new principles.

Reading.—Call the attention of the pupils to the *subject* of Reading Lesson No. 1. Let them notice, particularly, the illustrations, and *then* read the lesson. (While the pupils are engaged with any one lesson, it may be advisable to cover up the lessons below it, so that their attention may be given exclusively to the one lesson.)

Oral Composition and Writing.—Let them now form verbal compositions on the subject of No. 1, in the manner directed for the preceding Chart. If they have learned the script letters, Chart No. IX., let them write out some of these compositions.

Spelling.—Use the Type Letter-cards to set up this lesson, and also other lessons or compositions on the subject of No. 1. Also spell aloud the words.

Printing and Drawing.—Let the pupils print or write Lesson No. 1, and also others which they may form on the same subject. For Drawing, see directions, page 52–3.

Numbers.—The pupils having set up Lesson No. 1 with the type-cards, or printed it, let them count the letters in each line, placing the number at the end. Then let them place under each word the figure denoting the number of letters in it. Next, let them add aloud the figures in this latter row, and see if they can obtain the same number as in *counting* the letters. This is *addition*, and *proving* it. The teacher should show them how to write down numbers larger than 9.

All the foregoing exercises on the subject of Lesson No. 1 may be carried on nearly simultaneously with a large class; or so many of them as may be necessary to keep the class fully occupied. They may occupy several days. After

No. 1 has thus been disposed of, carry on, in a similar manner, a series of exercises for each of the remaining five subjects on this Chart. Pay attention to the inflections, etc., as before directed.

Punctuation and Capitals.—It is now time to begin to pay some attention to these; for as the pupil sees them used, he will naturally wish to know *why* they are used, and *when* they should be used. Point out the *period*, and *comma*, and *interrogation point*, on the Chart; show how they are usually made in books, and explain their uses.

Tell them that the *comma* marks the smallest grammatical division in written or printed language, and that where it is found there should usually be a short pause in reading. (We would have omitted the word "grammatical" in the above definition, if we could have made the definition correct without it.)

The *period*, which is placed at the close of a sentence, shows that a full pause, or full stop, should be made there.

Point out the interrogation point; tell them that "to interrogate," means "to ask a question," etc.; and that the interrogation point is placed at the end of a sentence which *asks a question.*

The pupils began the use of words without any capital letters. Explain now the *general* rules only for using capitals; such as, the first letter of a word after a period; names of persons and places; the pronoun *I*, and the interjection *O*.

CHART No. VI. READING: FIFTH LESSONS.

[The Reading Lessons in the Primer, or First Reader, should be continued in connection with the exercises on this Chart. The teacher should pay special attention to the directions given in the Readers for avoiding a *drawling* and *monotonous* manner of reading, especially with *beginners*. Continue the exercises on the Elementary Sounds.]

The Reading Lessons in this Fifth and last Series present a still greater variety than those of the fourth Chart.

Reading.—Call the attention of the pupils to the *subject*

of the first Reading Lesson, No. 1. Let them notice, particularly, the illustration, and then read the lesson; being careful to read in a natural and spirited manner, giving the inflections, etc. All the capital letters are given here; and those which pupils are not already familiar with, they should now learn.

Oral Composition and Writing.—Let the pupils now form verbal compositions on the subject of No. 1, in the manner directed for Chart No. IV. If they have learned the script letters, Chart No. IX., let them write out some of these compositions.

Spelling.—Use the Type Letter-cards to set up this lesson, some of the compositions on the subject, and the capital letters. Also spell aloud the words.

Printing and Drawing.—Let the pupils print or write the Lesson No. 1, including the capital letters, and other lessons or compositions which they may form on the same subject. Do not let them fall into the habit of holding their pencil improperly. For Drawing, see directions, p. 52–3.

Numbers.—Let the pupils continue the exercises of counting the letters in each line of the lesson, and adding the numbers denoting the letters in the several words in the lesson, as directed for Charts No. IV. and No. V.

In a similar manner go through with all the lessons on this Chart; after which, introduce the subject of Numbers again, with the following exercises:

1. Count the *words* in each lesson, and set down their numbers. Then add these numbers, and tell the number of *words* in *all* the lessons.

2. Count the *letters* in each lesson, and set down their numbers. Then add all these numbers, and tell the number of *letters* in *all* the lessons.

These exercises will require some instruction from the teacher in setting down larger numbers than the pupils have previously been accustomed to, and in carrying one for every ten. The first regular exercises in *addition* are thus introduced, and without any necessity for a separate Chart of Numbers. Moreover, the exercises in figures are

thus made *practical*, as the figures are here the representatives of the numbers of well-known objects. We would recommend, in the exercises in numbers at this early stage of the pupil's progress, that figures should *not* be used abstractly, but be made to represent, in all cases, certain objects with which the pupil is already familiar.

The teacher may now introduce other exercises in numbers, adapted to the capacities of his pupils. He may, for example, select such groups of words as "cat, cage;" "cat, quail;" "cat, yellow;" "cat, reading," etc. Let the pupils count the letters of the words in each group, and tell the difference in the number between *cat* and *cage*, *cat* and *quail*, etc.; then the difference between the number of *words* in one line, and those in another line; then the difference between the number of *letters* in one line, and those in another line; thence proceed to the words and letters in entire lessons; thence to the words and letters on entire charts, etc. Such exercises will interest pupils much more than such as require them to deal with *abstract* numbers only. The *idea* of the difference between the number of letters in one word, and the number in another word, is first acquired by the pupil; and *then*, when the want is felt, an *expression* for this idea is sought. This is the true *object* method.

Punctuation, Capitals, etc.—A more full account of the pauses, capitals, etc., may now be given, and their uses illustrated, as far as can be done, from the present Chart. Here are presented the *comma*, *semicolon*, *colon*, *period*, *interrogation* and *exclamation points*, the *rising* and *falling inflections*, *emphatic words*, and the *hyphen*. The following may aid the teacher in explaining to the pupils the uses of these marks. For full information on this subject, however, we would advise him to read "A Treatise on English Punctuation, by John Wilson."

The *comma* (,) marks the smallest grammatical division in written or printed language, and usually represents a short pause in reading or speaking.

The *semicolon* (;) is used to separate such parts of a sentence as are somewhat less closely connected than those separated by a comma. It is also frequently placed between two or more distinct parts of a sentence, when these parts, or any of them, are divisible by commas into smaller portions.

The *colon* (:) is used in a sentence between parts less connected than those which are divided by a semicolon, but not so independent as sep-

arate, distinct sentences. Thus: "It is not a cloak, nor a coat: it is a shawl." The following are good illustrations of the use both of the colon and of the semicolon.

Avoid affectation; for it is a contemptible weakness.

Avoid affectation: it is a contemptible weakness.

The omission of the conjunction *for* requires us to change the pause from a semicolon to a colon.

The *period* (.), or full point, indicates the end of a complete and independent sentence. It is also to be used after every abbreviated word, as Wm. for William, Mass. for Massachusetts.

The *interrogation point* (?) is placed at the termination of every question.

The *exclamation point* (!), indicating passion or emotion, is placed after expressions denoting any sudden or strong emotion.

The *hyphen* (-) is used to join the constituent parts of certain compound and derivative words; and also to divide words into syllables for the purpose of exhibiting their pronunciation. There are many compound words which were originally written with a hyphen, but which are now presented to the eye as one word, as *bookseller*, *nobleman*, etc.

CHART No. VII. ELEMENTARY SOUNDS.

[It is of considerable importance that the child should be exercised in the elementary sounds of our language; but these exercises should be introduced *after* the child has learned to call words with considerable facility; and they should be continued in connection with, and as an adjunct of, his reading lessons, until both his ear and his voice have received the proper degree of training. See page 9, and also pages 35,38.]

Chart No. VII. is designed to represent the principal elementary sounds of our language, and to furnish exercises by which the ear may be trained to distinguish them in spoken language, and the organs of voice to utter them, when combined in words, with the propriety of good usage. *Correct* enunciation is the basis of all good reading; but this is equally removed from an affected nicety of articulation on the one hand, and a careless and slovenly manner on the other. Both extremes are to be avoided.

In the following exercises in articulation, care should be taken to give the elementary sounds, when uttered separately, just that degree of force and prominence which they have when combined with others in the representative words, when these words are uttered clearly and distinctly *in discourse*. Elocutionists, in pronouncing the words separately, frequently *prolong* the elementary sounds

—especially the vowel sounds—far beyond what is appropriate in good reading; and this is apt to produce an unnatural and affected articulation in their pupils. Give the elements just that degree of prominence which they have when the words which contain them are uttered in a neatly spoken *sentence.*

EXERCISES ON THE CHART.

I. VOWELS OR VOCALS.*

Long Sounds of the Vowels.

1. Let the teacher, using a pointer, point separately, and in order, to the first word in the first column, the accompanying vowel in the second column, and the word in the third column, while, at the same time, the pupils in concert pronounce each distinctly, thus, "mind, I, ice," giving to the vowel in the middle column the same sound that it has in each accompanying word. Pass over the three columns in this manner.

2. Pass over the second and third columns, repeatedly, in the same manner, beginning with the vowel sound.

3. The teacher points to the words *ice*, *eat*, *ale*, etc., and the pupils utter the corresponding elementary vowel sounds only, in this manner going through the entire list. The vowel sounds are so arranged as to correspond with the order of the changes in the position of the mouth in their formation, that when one sound is finished the mouth will be in the proper position for commencing the next sound.

4. Combine each of the elementary long vowels with all the aspirates and sub-vocals, excepting *Zh* and *Ng*. Thus, the teacher tells the pupils to take P, and, connecting it with each long vowel, to pronounce the syllables thus formed, and then to utter the vowel sound separately. As the teacher points to the words *ice*, *eat*, *ale*, *air*, *arm*, etc., the pupil pronounces pī, ī; pē, ē; pā, ā; pâ, â; pä, ä, etc.

* "A vowel is a smooth emission of sounding breath, modified, but not obstructed by the organs of speech."—*Graham.* They produce what are called the *pure tones.*

5. Next, in a similar manner, have the vowel sounds *precede* the aspirates and consonants; but select such aspirates and consonants only as are appropriate for this purpose. Thus, taking P, the pupil pronounces īp (īpe) ī; ēp (ēpe) ē, etc.

Short Sounds of the Vowels.

Next take up the short sounds of the vowels, and go through with them also, in five series of exercises, similar to those already given for the long sounds.

Double Sounds.

These may be treated in a similar manner.

Additional Exercises.

Now let the teacher exercise the pupils on the words given on Chart No. I., in a manner similar to the course just marked out.

I. A.—Next let him require the pupils to write on the blackboard, or set up with the Type Letter-cards—

1. All the words they can which give the sound of *long* ā, as in āle, āpe, bāit, dāte, slāte, gāte, tāme, flāme, wāve, sāve, whāle, etc.* If they write them, let them make the appropriate mark over the vowel. If they set them up on the composing-frame, let them designate each series by a figure, as they are designated here: 1 for ā, 2 for ä, 3 for a̤, 4 or ă, etc.

2. Proceed in the same manner with those which give the sound of the *Italian or grave* ä, as ärm, bärn, färm, fär, fäther, stär, cär, jär, härpy, härd, märtyr.

3. Those which give the sound of *broad* a̤, as in a̤ll, ca̤ll, fa̤ll, ta̤ll, spra̤wl, squa̤ll, ha̤ul, wa̤lk, ta̤lk, wa̤rm, swa̤rm.

4. Those which give the sound of *short* ă, as in ăt, făt, lăd, hăt, săt, căt, săd, măn, păn, tăn, căn, cărry, begăn, nătural.

5. Those which give the sound of *long* â before *r*, as in âir, câre, fâre, fâir, beâr, bâre, pâir, stâir, stâre, dâre, compâre, forbeâr, declâre.

6. Those which give the sound of ȧ (intermediate between ă and ä), as in ȧsk, lȧst, fȧst, pȧst, pȧss, grȧss, brȧnch, chant, advȧnce, lȧnce, slȧnder.†

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* The *teacher*, at least, should be supplied with a dictionary which gives the vowel sounds of all words in the language. It is unfortunate that all the dictionaries do not agree in giving the *same* signs to represent the *same* sounds. We have adopted, here, the signs used in several of Webster's dictionaries, and especially the "Pronouncing and Defining Dictionary," edited by Prof. Goodrich.

† With respect to this class of words there is much diversity among orthoepists, and also among good speakers, some giving to many of

[Give words in which *a* has the sound of short ŏ; as in what, wash, swan, swamp, swap, swash, swallow, quality, was, wan, quadrangle, scallop, chaps. Do not confound them with the sound of a in sward, swarm, fall.]*

II. E.—7. Those which give the sound of *long* ē, as in ēat, mē, bēard, kēy, mēte, sēal, fēar, kēēp, bēēt, bēat, bēēf, lēaf, procēēd, precēde, indēēd, benēath.

8. Those which give the sound of *short* ĕ, as in nĕt, mĕt, mĕn, mĕrry, friĕnd, sĕll, tĕll, bĕll, stĕp, frĕt, brĕad, trĕad, hĕad, kĕg, lĕg, tĕll, fĕll, guĕss, prĕss.

9. Those which give the sound of *short* ė before *r*, as in hėr, eȧrth, tėrm, vėrge, vėrdure, prefėr, confėr, hėrd, fėrvid, fėrn, kėrsey, mėrcy, mėrchant.

[Give words in which *e* has the sound of *long* ā, as in there, their, where, heir. This is in accordance with both Webster's Pictorial Edition and Worcester; but perhaps the most common usage gives the *e* in these words the sound of â in câre. In prey, survey, they, etc., the *e* has clearly the sound of *long* ā.]

III. I.—10. Those which give the sound of *long* ī, as in īce, nīce, pīne, fīne, nīne, tīme, wīne, īsle, pīle, tīle, nīght, plīght, tīght, heīght, oblīge.

11. Those which give the sound of *short* ĭ, as in pĭn, tĭn, fĭn, sĭnce, wĭnce, pĭt, sĭt, hĭt, fĭll, pĭll, mĭll, untĭl, mĭss, hĭss, mĭrror, bĭd, hĭd.

[Give words in which *i* has the sound of *long* ē, as in pique, machine, mien, marine, antique, unique, caprice, bombazine, ravine, routine, police.

Give words in which *i* has a short sound verging toward *u*, as in bird, firm, sir, fir, dirt, girt, virtue, virgin, bestir.]

IV. O.—12. Those which give the sound of *long* ō, as in ōld, tōld, mōuld, sōld, nōte, denōte, vōte, ōh, nō, dōme, lōam, cōurse, rōll, pōrt, dōōr, flōōr, yeōman.

13. Those which give the sound of *short* ŏ, as in nŏt, ŏn, blŏt, bŏnd, fŏnd, pŏnd, cŏral, fŏx, ŏx, hŏt, nŏvel, shŏt, dŏn, ŏdd, bŏrrow, mŏrrow, pŏlish.

14. Those which give the sound of ö like *long oo*, as in möve, pröve, dispröve, dö, tö, tömb, löse, whö.

[Give words in which *o* has a sound like *short* ŭ, as in dove, love, son, done, worm, does, none, come, money.

Give words in which *o* has the sound of *u* in bull. Ex. wolf, woman, Wolsey.

Give words in which *o* has the sound of *broad* a in call. Ex. nor, for, form, sort, ought, fought.]

V. U.—15. Those which give the sound of *long* ū, as in ūse, mūte, cūbe, dūty, ūnite, tūbe, tūne, sūit, fūme, pūre, hūe, dūe, sūe, lūte, rūle,

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them the Italian sound of *a* as in *far* and *father*, others giving them the short sound of *a* as in *at*, *man*, and others still, avoiding the two extremes, giving it an *intermediate* sound, as we have represented it.

* It may be well for the teacher to omit for the present the examples in brackets, until the pupils have become familiar with the sounds which are more strictly elementary.

rŭde, brŭte, trŭe.* The *long* ū has the sound of *yu*, slightly approaching *yoo*, when it *begins* a syllable; but in other cases it is difficult to distinguish the sound of the *y*.

16. Those which give the sound of *short* ŭ, as in sŭn, ŭp, bŭt, tŭb, tŭn, hŭt, jŭst, dŭst, fŭn, gŭn, cŭll, bŭzz, sŭng, thŭmb, vŭlgar, hŭrry, mŭrmur.†

17. Those which give the sound of *obtuse* ṳ, as in pṳll, pṳt, bṳll, fṳll, bṳsh, pṳsh, pṳss, coṳld, woṳld, shoṳld, sṳgar, bṳtcher.

VI.—18. Those which have the sound of *ou* or *ow*, as in our, sour, bower, howl, owl, foul, found, hound, pound, sound, mound, noun.

19. Those which have the sound of *oy* or *oi*, as in boy, toy, joy, annoy, destroy, convoy, oil, boil, toil, foil, soil, turmoil.

[Give words in which *ew* has the sound of *long* ū, as in few, mew, dew, pew, new, hew, ewe, slew, eschew.]

The foregoing exercises carry the elementary vowel sounds sufficiently far for the uses of the school-room; but it must not be supposed that they represent *all* the variations of sound given *to each vowel*. One vowel sometimes takes the sound of another vowel. From Graham's Phonography we quote the following:

"The letter *a* has eight different sounds, as in the following words—*mate*, *many*, *pare*, *at*, *farm*, *pass*, *all*, *what*.

"The letter *e* has six different sounds, as in *mete*, *pretty*, *they*, *met*, *her*, *there*.

"The letter *i* has five different sounds, as in *machine*, *if*, *bird*, *bind*, *union*.

"The letter *o* has nine different sounds, as in *woman*, *form*, *hop*, *ope*, *whole*, *son*, *move*, *women*, *one*.

"The letter *u* has seven different sounds, as in *busy*, *bury*, *cut*, *rule*, *usage*, *persuade*, *pull*, *unite*."

II. CONSONANTS.‡

The Aspirates, or Whispered Consonants.

1. Let the teacher exercise the pupils in sounding the *Aspirates* in the same manner as the first exercise was

* Worcester says, "When *u* is preceded by *r* in the same syllable, it has the sound of *oo* in *fool*." Hence the words *rule*, *rude*, *brute*, *true*, he pronounces *rool*, *rood*, *broot*, *troo*. Although this pronunciation prevails in some quarters, we do not think it has yet become established by the usage of the *majority* of good speakers. It is well enough to *recognize* it, however, as some speakers are very tenacious of it.

† Worcester makes a distinction between the *u* in *hurry* and the *u* in such words as *fur*, *hurt*, *further*, calling the former the *short* sound, and the latter the *short and obtuse* sound of *u*. We think the difference, if there is any, too slight to require the distinction.

‡ A consonant is a sound made by an emission of breath, while at the same time there is either a complete or partial contact of the vocal organs, which obstruct the breath in some degree. None of the conso-

given under the head of the "Long Sounds of the Vowels." Thus, articulate "cap, p, pink," *giving to p its consonant sound only.*

P. To produce the separate sound of *p*, close the lips, and suddenly force them apart with the breath. Or gradually separate the sound of the syllable ăp, and finally drop the sound denoted by ă. Or attempt to pronounce the word *pink*, but go no farther than the sound of *p*.

T. To produce the sound denoted by *t*, separate the sound of *t* from *eat* or *tea*. Or begin to pronounce *tin*, and stop with the sound of *t*.

K. Separate the sound of *k* from *ken* or *oak*. Thus, ken, k-en, k—en, k—.

Ch. Separate the *ch* sound from *latch*. Or begin the pronunciation of *chair*, and stop with the *ch* sound.

In this manner the separate aspirate sounds may be easily learned and uttered.

2. Let the teacher now form for his pupils a series of excises on the Aspirates *similar* to those given for the long sounds of the vowels.

Sub-vocals.

Let the teacher proceed with the Sub-vocals in the same manner as with the Aspirates.

Composition.—Require those pupils who are old enough, to write compositions on the subjects in the foregoing exercises on Chart No. VII.—telling what constitute *vowels*, some of the different sounds given to each, what are *conso-*

nants can be fully pronounced without the help of a vowel; but when we pronounce them as independently of a vowel as it is possible to do, we find that the sound of one portion of them will be that of a whisper, while the sound of the others will be given at the natural pitch of the voice, and will also contain more of a *vocal* articulation.

Thus. notice the difference in sounding *p* and *b*. Closing the lips, and suddenly forcing them apart with the breath, gives the sound of *p*, and *no sound is heard until the actual opening of the lips.* But in sounding *b* an undertone or sort of murmur is made by the vocal ligaments *before* the opening of the lips. This difference has led to a division of the consonants into "Aspirates," or whispered consonants, and "Consonants" proper, or "Sub-vocals."

Dr. Rush's classification of the elementary sounds is into twelve *Tonic* (vowel) Sounds, fourteen *Sub-tonic* (sub-vocal) Sounds, and nine *Atonic* (aspirate) Sounds.

nants, how divided, character and use of the exercises on this Chart, etc.

CHART No. VIII. PHONIC SPELLING.

The system of written *phonics*, or *phonetics*, consists in giving only *one* distinct sign or representation to each elementary sound in the language. There are said to be about forty-six elementary sounds in the English language, and these would consequently require an alphabet of forty-six letters. In such an alphabet any one letter would always represent *the same sound*.

With our present system of orthography it is impossible to tell, from the written or printed representation of a word, how the word should be pronounced, because frequently the same letter has, in different words, very different sounds, and the same sound is often represented by a great variety of combinations of letters. Thus the sound of *long* ā is represented by no less than sixteen different signs. Thus, by *a* in *mating*, *a-e* in *mate*, *ai* in *pain*, *aigh* in *straight*, *ao* in *gaol*, *au* in *gauging*, *au-e* in *gauge*, *ay* in *pray*, *aye* in *prayed*, *ea* in *great*, *ei* in *veil*, *eig* in *reign*, *eigh* in *weigh*, *eighe* in *weighed*, *ey* in *they*, and *eye* in *conveyed*.*

In a similar manner, *long* ē may be shown to have seventeen different signs, *long* ī sixteen, etc.; so that our language has not less than three hundred signs to represent about forty-six elementary sounds. On the other hand, to represent sixteen vowel sounds (as some give them), our language furnishes but five letters (a, e, i, o, u). As a farther instance of the anomalies in our language, the combination *ough* in the following couplet has seven different sounds:

"*Though* the *tough cough* and *hiccough plough* me *through*,
O'er life's dark *lough* my course I will pursue."

It has still another sound in the word *bought*. How should

* See Graham's Hand-book of Phonography, page 11.

we know, therefore, how to pronounce the name of one of England's greatest statesmen, "Brougham?" Thus it might be Bro-am, Bruf-fam, Brof-fam, Brup-pam, Brow-am, Broo-am, Brock-am, or Braw-am.

Phonic Spelling, or spelling by sound, as represented on Chart No. VIII., consists in uttering separately the *sounds* (and not the letters), and then combining them in the pronunciation of the word. Its chief utility consists in making the ear thoroughly familiar with the elementary sounds of the language, and in producing a distinct and elegant articulation. Chart No. VIII. is, therefore, merely an extended application of the principles illustrated in Chart No. VII.

Exercises.—1. Let the teacher, pointing to the word *bat*, pronounce it, and then require the pupils to spell it by sound, and also pronounce it. Continue in this manner through all the vowel sounds represented on the Chart.

2. Under the head of "Combinations of Consonant Sounds," pronounce, first, each *element* separately, and then the whole word. Thus, in the word *black*, there are four elements represented, *ck* forming but one.

3. Next, pronounce the consonants in groups, as indicated by their grouping. The teacher may extend such exercises to any length, by writing additional words on the blackboard, for the use of the pupils.

Phonetic Analysis.—This is the opposite of phonic spelling, or synthesis, and consists in dividing words into their vocal elements. It directs the attention, especially, to those letters and combinations that have *the same sound*, and also to slight differences of sound, and is, therefore, a useful exercise in cultivating the ear to nice discrimination. Here the student, in making the analysis, can not be guided at all by the common orthography, but by the *sound* only.

The teacher may pronounce such words as aid, ail, air, ought, eyed, owed, food, edge, George, John, right, know, faint, all, claws, meed, caught, sight, condemn, tongue, rowed, etc., and require the pupils to give their spoken elements. Thus, *ought* has only two sounds; *though* only two, etc. The teacher may write such on the board, or give them out by dictation.*

* An objection to the system of written phonetics seems to be, that it furnishes no means of distinguishing between words of different orthog-

Where pupils have been taught the phonetic alphabet, they may write the words in the phonetic letters.

Composition.—Let pupils write compositions on this subject of Phonetics; telling what it is; the advantages in favor of having a phonetic alphabet; the objections that may be urged against it, etc.

CHART No. IX. WRITING.

Only a few specific directions need be given for the use of this Chart. *Writing* has been referred to in connection with the exercises on Charts Nos. IV., V., and VI.; and it is supposed that during these exercises the pupils will learn the use of the script letters. They should begin their use in the following manner:

Having learned to recognize the words on Chart No. I., and to print their letters, they should next, in the same manner, learn to recognize them in their script forms, and to make their script letters. Thus, let them begin with the word *cap* on the Writing Chart. They need not begin with the elementary straight and curved lines of the letters, but may make the entire letters, in which they will necessarily use all these *elements*. The sixteen words given on the upper part of the Chart contain all the letters of the alphabet. The use of the capitals will be gradually learned in the same manner as the use of the printed Roman capitals.

Pupils may practice writing the sixteen script words on their slates, or on the blackboard, having the Chart before them. They may next write them, beginning each with a capital letter. Sentences may also be given them to write, having the Chart before them as a guide. One pupil may also set up sentences on the composing-frame with the Type

raphy and different meaning, that are pronounced alike. Thus, *Wright*, *rite*, *right*, *write*, are written alike in phonetics. However, it may be replied, we must distinguish between them by the *context*, just as we are compelled to do when they are *spoken*.

Letter-cards, and others may write them on the blackboard, on their slates, or on paper.

The teacher should be very particular to have the pupils make the letters as neatly and as accurately as possible, *from the very beginning*, and not allow them to form careless habits of writing.* If they write with either a lead pencil or a slate pencil, they should have it long and sharp-pointed, and should be required to hold it as they would hold a pen. At the proper time pupils may be supplied with *writing-books.*

Writing-masters usually direct their pupils to sit with the "left side to the desk." This is a constrained and unnatural position, and soon becomes wearisome; the pupil then seeks relief by inclining his body forward, thereby contracting the lungs, and producing weakness of the chest, the forerunner of consumption. Several physiologists have very justly taken exceptions to such a position, as in violation of well-known physiological rules.

The most natural and easy position seems to be at a *level* and rather high *table*—the *right side* to the table, and the paper square with the table. This is the *natural* position usually taken by lawyers, copyists, etc., who have much writing to do. If an inclined *desk* be used, we would advise a position with the right side *partially* to the desk, so that the elbow of the right arm may rest on the desk. In any case, the back should be supported, and *the body should be kept erect.*

CHART No. X. DRAWING.

PART I. FIRST LESSONS IN DRAWING.

Some teachers begin their lessons in drawing with the formation of straight lines, vertical, horizontal, oblique, and

* We have represented the letter *w* in two forms: one in the word *owl*, and the other as seen in the alphabet. We prefer the latter. We have given on the Chart the "Spencerian" form of the letters. If the teacher should prefer any other forms, there is no objection to his using them, if he can make them very neatly.

angular, and these they follow with exercises in forming curved lines. Chart No. XI. will furnish an abundant variety of such lessons, if teachers think best to follow this system.

Others very justly object to this mode of teaching drawing as unnatural and devoid of interest to the pupil, and prefer to begin simultaneously with both kinds of lines, as they are found combined in the outlines of the forms of real objects, as we have represented them in the upper part of Chart No. X. It is not often that we are required in drawing to make a continuous straight or curved line with one stroke of the pencil, and hence there is little reason for practicing upon such lines.

If the picture of a cap like that on Chart No. I. be given a child for a drawing lesson, the child, if it has had no previous instruction in drawing, will be very apt to begin with making heavy black marks for the outline, and these marks will be very certain to be wrong. They are then so heavy that they can not be corrected, and the child has to begin a new drawing. This will, perhaps, be equally faulty, and another drawing will be begun; and so on until half a dozen or more attempts have been made, and the child becomes discouraged.

The child should be taught to begin with making the *faintest outline possible* of some important part of the picture: it should then examine this outline carefully, and, *without rubbing out* any thing, correct it by a new light tracing. Let it continue thus until the outlines of the whole picture are satisfactory. The correct tracings may *then* be made a little firmer, like the outlines of the cap as given on this Chart. It will then be easy to fill up with lines of shading, as they are seen in the picture of the same cap on Chart No. I. These pencil lines of shading, however, should be made *much lighter* than they are in the engraved and printed picture. Children are inclined to go to the extreme of making a picture *as black* as possible. They should be encouraged to make all their drawings *light*, even when they are fully shaded; and they should

be shown that the most striking parts of a picture are usually those which are left almost or wholly *white.*

After the pupil has drawn an outline of the cap, as in Chart No. X., and shaded it, as in Chart No. I., he should be required to make a drawing, in the same order, of a *real* cap.

After this introduction of the subject, we would advise that pupils should be required to make drawings from Chart No. XIX. of the forms of leaves, stems, roots, and flowers represented there, being careful to sketch the outlines very lightly at first; and that after each drawing—if it be of a leaf, for example—a similar real leaf should be placed before them as a copy, that they may thus be continually *drawing from Nature.*

They may next return to Chart No. X., and copy, in order, the outlines of objects there represented. After making one of these outlines, as directed with reference to that of the cap, and then shading it as shown elsewhere in the completed picture, the object itself, or some other familiar object, and a similar one if possible, should be placed before them to copy. In all cases the *picture* should be used merely to teach the children *how* to draw *similar natural objects.**

The complete picture of the *pear*, *jug*, and *face* will be found on Chart No. I.; that of the *fish* in the Fifth Reader, page 227; but that on Chart No. I. may be drawn as well. The completed picture of the *cat* may be found on Chart No. VI.; that of the *boy reading* on Chart No. V.; *domestic fowls* on Chart No. XVII.; and the *horse*, etc., on Chart No. XV. In drawing a picture of the human face,

* Drawing, as usually taught in our schools, is little more than *copying pictures*—a very profitless exercise, except as it does cultivate a taste for pictures or paintings generally; but it fails in cultivating a taste *for Nature;* and its utility is the very doubtful one of copying a copy, instead of copying the originals. Drawing and painting lessons should have direct and *constant* reference to drawing and painting from Nature; and if the system we have here so briefly sketched be tenaciously adhered to, the desired results will not be difficult of attainment.

the *eye* should be first drawn, as, if that should be wrong, all the rest would be spoiled.

The teacher will find on the Charts, and throughout the School and Family Readers, a great variety of pictures, from which he may select copies for his pupils; and he should be careful to select, in the early lessons, such as they are most familiar with, and of which they can find representatives in real objects in Nature to copy from. Let them copy from the upper part of Chart No. XX. the parts of flowers as there represented, and then find similar parts to copy from in the natural flowers. Let them copy, from Chart No. XXI. the forms of the roots of well-known plants, and let them bring in drawings of similar roots from Nature. Be careful to have them begin each picture by *sketching the outlines very lightly;* and do not let them shade any of them *too heavily.* Accustom them to *copy much from Nature.* Let them make drawings of books, tables, chairs, and desks, and of old fences, the stumps of trees, rocks, etc. They should not attempt *buildings* until they have learned something of Perspective.

PART II. GEOMETRICAL DRAWING.

Children delight to exercise their constructive powers in *making* things: the girls, in cutting out patterns and making dresses; the boys, in using the hammer and nails, the gimlet, the hatchet, the saw, the plane, the rule and compasses, in planning and constructing toys and machines, and in making diagrams of geometrical figures. What their elders and superiors do, children not only desire to know *how* to do, but they wish to *do* it also: labor—work—is with them an instinct of their very being, fraught with health and happiness; and if, throughout childhood and youth, they could have suitable training, by way of recreation and amusement, in the principles and practice of CONSTRUCTION, they would not make the *inefficient* men and women that we now class among the drones of society. The strong propensity, especially in boys, for using "tools," and "*making*" things, should not, therefore, be checked, but

judiciously guided and trained as a part of the business of their education. It will thus lead, naturally, and without impediment to any thing else useful, to those attainments in knowledge, and that skill in art, that combine to make the scientific and practical farmer, the master mechanic, or the engineer. Our educators should look more to this hitherto almost wholly neglected part of education.*

Carrying out the above principles in part, under the head of GEOMETRICAL DRAWING, on the Chart, we have introduced some interesting and useful problems in lines and forms, for practice in the school-room. While these exercises are calculated to train the eye and the hand to accuracy and neatness in *drawing*, they will also cultivate the inventive faculties, and give children the gratification of knowing how easily some apparently difficult things are done; such things, also, as will be apt to come up for use in many ways in their future studies, and in practical life. It should not be deemed sufficient for children to *tell how* these figures are drawn. They should *draw* them; and for this purpose they should be provided with a ruler, also with a pair of dividers or brass compasses, to one leg of which a short lead pencil, shaved flat on one side, may be firmly tied, for drawing the circles.

We would also further remind the teacher that the pupil should not be expected, at this early stage, to proceed to the *demonstrations* of these problems. After the pupil has solved the first problem, he should be left for a while to his own ingenuity in solving each subsequent one. After he has learned to bisect a given straight line, he has the key to the next three problems; and if, unaided, he can accomplish their solution, the knowledge thus acquired will be wholly his own, and will be prized accordingly, and the great value of systematic contrivances will begin to be

* *Manual Labor Schools* have not been eminently successful in an educational point of view, because the labor required has not been *planned* with reference to educating the faculties, but only with reference to material profits in dollars and cents. Hence the labor has often been, in an educational aspect, an injury rather than a benefit.

appreciated. Let this process of self-instruction be carried out extensively, but not so far as to check the ardor and dampen the curiosity of the pupil. Moreover, as the pupil progresses from one step to another, let the teacher bring in all the illustrations possible, showing the relationship between these problems and constructive art, and especially in the construction of tools and machines with which the pupil is familiar.

Fig. 1.—*To bisect a given straight line;* that is, *to divide it into two equal parts.*

Let AB be the given straight line. From the centre A, with a radius* greater than the half of AB, describe two arcs* of a circle, as at C and D; and from B, with the same radius, describe the two arcs of another similar circle, intersecting the first at C and D. The straight lines connecting the points of intersection will bisect AB in O. (The line COD will also be perpendicular to the line AB.)

Fig. 2.—*From a given point in a straight line, to draw a perpendicular† to this line.*

Let EF be the given line, and O the given point in it. In the straight line EF take any point, E, and make OE equal to OF. From E, with a radius greater than EO, describe an arc above O; and from F, with the same radius, describe another arc intersecting the first at G. Draw GO, and this line will be perpendicular to EF.

[Explain what is meant by a *perpendicular*, and also show that a perpendicular line may be in a horizontal, or in any other position. What lines in the school-room are perpendicular to certain other lines? The explanation of a perpendicular will show that each of the angles EOG and GOF, in Fig. 2, is a right angle. Give pupils a straight line, and ask them to form a right angle at a given point in it; then two right angles on each side of the line. Describe the form of the wooden *level* and plummet which masons and carpenters often use for determining whether a wall or a beam is level or not. Ask them how they would make this level. Could an iron *square*, such as carpenters use, be made without knowing how to draw one line perpendicular to another? How would they make a *wooden* square, to answer the purposes of the iron square?]

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* Describe what is meant by a *radius*, and what by an *arc*. See page 80, and Chart No. XI.

† Describe what is meant by *perpendicular*. See page 80, and Chart No. XI.

After having drawn Fig. 2, see if the pupil, unaided, can draw an equilateral triangle.* It is done by describing the arcs which intersect at C, with a radius equal to EF, or FE, and then connecting the three points E, C, and F. See, also, if the pupil can describe, on a given line, an isosceles triangle, each of whose equal sides shall be double of the base. Next describe a similar triangle on the other side of the line.

Fig. 3.—*From a given point without a straight line, to draw a perpendicular to this line.*

Let HI be a straight line of unlimited length, and O the given point without it. From O, with a radius greater than the nearest distance to the straight line, describe an arc cutting the line in two points, H and I. Then from the points H and I, as centres, and with radii† greater than the half of IH, describe two arcs cutting each other in the point J. Draw OK in the exact direction of the point J, and OK will be perpendicular to HI. [HK and IK will also, evidently, be perpendicular to OK at the point K.]

Fig. 4.—*To draw a square on a given straight line.*

Let BA be the given straight line. First, from the point A, draw AG perpendicular to BA, and take AE equal to AB by measuring. Then, from the point E in the line EA, draw EH perpendicular to AE, and make EH equal to AB. Draw HB in a similar manner, and the square will be completed.

In order to draw AG perpendicular to BA, extend BA in the direction of D; take any distance, such as AC, and make AC and AD equal. Then from the centres C and D, with equal radii greater than CA, draw the two arcs intersecting at G. Draw a line from G to A, and this line will be perpendicular to BA. The point G might have been taken below E. In a similar manner EH is drawn from the point E perpendicular to AE.

Fig. 5.—*To find the centre of a given circle or arc.*

Let JKLM be the given circle, or JKL the given arc.

* A triangle having three equal sides.

† Explain that *radii* is the plural of *radius*.

Take any three points in the arc, or any three in the circle, as J, K, L; join JK and KL; bisect each by the perpendicular lines UT and RS, and their point of intersection, O, will be the centre of the given circle or the given arc. JK and KL are bisected by perpendiculars, similar to Fig. 1.

Now give the pupils this problem: *To describe the circumference of a circle through any three given points.*

Fig. 6.—*To divide a given angle, or a given arc, into two equal parts.* (That is, to *bisect* them.)

Let ACB be the given angle. From the centre C, with any radius, describe an arc AB. Draw the straight line (the chord*) AB. Bisect AB by the perpendicular CE, and the angle ACB will be divided into two equal parts.

If AB be the given arc, draw the straight line (or chord) AB, bisect it by the perpendicular EC, and this will bisect the arc.

Fig. 7.—*To inscribe a circle in a given triangle.*

Let GHF be the given triangle. Bisect H and F, any two angles of the triangle, by the lines HN and FM. Their point of intersection at O will be the centre of the required circle. Then from the centre O, with a radius equal to the nearest distance of any one of the sides of the triangle, describe a circle, and its circumference will also touch the other sides of the triangle.

Fig. 8.—*To describe a circle about a given triangle.*

Let ABC be the given triangle. Bisect AB and AC, any two of the sides of the triangle, by the perpendiculars GF and HI. Their point of intersection at O will be the centre of the required circle. From this centre, with a radius equal to the distance of any one of the angles of the triangle, describe a circle, and its circumference will also pass through the other angles.

Fig. 9.—Five problems.

1. *To inscribe a square in a given circle.*

If you do not know the centre of the circle, find it, as described under Fig. 5. Through the centre, O, draw the diameter KL. Through O draw MN perpendicular to KL.

* For the definition of a *chord*, see page 80, and Chart No. XI.

Connect the points M, L, N, and K, and the square will be formed.

2. *To describe a square about a given circle.*

Draw, as just described, two diameters of the circle, KL and MN, at right angles to each other. Draw perpendiculars at the extremities of these diameters, and the square will be formed.

3. *To inscribe a circle in a given square.*

Take the outer square PRTS, connect the opposite angles, and from their point of intersection inscribe a circle with a radius equal to the nearest distance to any one side of the square; or bisect any two adjacent sides of the square by perpendiculars, and their intersection will give the centre of the circle, and the length of the radius for inscribing the circle.

4. *To describe a circle about a given square.*

Let KMLN be the given square. Connect the angles of the square by the two diameters MN and KL, and from their intersection at O describe a circle with a radius equal to either of the semi-diameters, OM or OL, etc.

5. *To inscribe a regular octagon in a circle.*

In the circle inscribe the square KMLN; bisect the arc cut off by each of its sides, which will give the points U, V, etc. Connect KU, UN, NV, VL, etc., and a regular octagon will be inscribed in the circle.

A continued subdivision of the arcs thus obtained would give figures of 16 sides, 32 sides, 64 sides, etc.

Fig. 10.—*To inscribe a regular hexagon in a given circle.*

From the centre of the circle, A, draw the radius AB. Apply the radius AB six times to the circumference, and the hexagon will be formed, as shown in the figure.

Now ask the pupils how they would form a regular polygon of 12 sides.

Ask them how they would draw six equilateral triangles in a circle. If they were required to draw one equilateral triangle, having a side of it equal to a given straight line, how would they do it? (Describe a circle whose radius

should be the given straight line; then describe another circle, with the same radius, having its circumference pass through the centre of the first circle, and it will be readily seen how the triangle can be formed.) A knowledge of the construction of the hexagon will enable pupils, after a very little study, to construct the diagram of the Chromatic Scale of Colors, Chart No. XIV.

Fig. 11.—*To inscribe a regular pentagon in a given circle.*

The centre of the circle being found, draw the radius HI, and from the point H draw HL at right angles to it. Bisect HL in J; connect JI; then make JK equal JI. Now apply HK to the circumference of the circle, beginning at L, and it will be found to exactly measure the circumference *ten* times. Connect the alternate points obtained by this measurement, as shown in the figure, and a regular pentagon will be formed.

How, then, could a regular decagon be formed? A regular polygon of 20 sides?

Now suggest to the pupils the following problem:

To construct an adjoining pentagon on each of the five sides of the pentagon, Fig. 11, *and each equal to Fig.* 11.

This may be easily done in the following manner: Take a side of the pentagon, say 5 7, and bisect it by a perpendicular, such as HK extended outwardly. Then, on this perpendicular as a diameter, describe a circle that shall cut the circle of Fig. 11 in the points 5 and 7. Then 5 7 will be one of the sides of the adjoining pentagon, and the other sides may be easily laid off around the circle. In a similar manner construct each of the adjoining five pentagons.

The knowledge of this construction is essential to the forming of the solid called the *dodecahedron*. See page 62.

Let them also exercise their ingenuity upon the following problem: Describe three equal circles touching one another; and also describe another circle which shall touch them all three.

Fig. 12.—*To describe an ellipse.*

As an ellipse is a figure that in form approaches a *circle* on the one hand, and is contracted to almost a *straight line* on the other, we have drawn three of them.

1. To draw the inner ellipse.

Suppose it be required to draw this ellipse on a smooth board.

Take any two points, A and D, and into each point drive a pin; tie a string, AD, to these pins, one end to each pin, and leave the string sufficiently loose to reach to T; then putting a pencil-point inside the string, and fully stretching out the string, move the pencil-point around against the string, and it will form on the board the inner ellipse.

The points A and D are called the *foci* of the ellipse.

2. If C be taken as one of the foci, while the other remains at A, the same length of string will give the form of the second ellipse.

3. If B be taken as one of the foci, while the other remains at A, the same length of string will give the form of the outer ellipse.

If the two foci should be brought much nearer to each other, with the same length of string, the ellipse would approach closely, in form, to a circle. The farther apart the foci are, the more will the ellipse be contracted in width.

How would the pupil draw a large circle in the garden—so large that he could not use a pair of compasses, or dividers?

He might use a narrow strip of board, with a peg at each end, driving one of the pegs firmly into the ground, and using the other peg to mark with. Or he might use a rope, with a peg at each end.

How would he draw a large ellipse in the garden?

Additional Exercises.

To construct the five regular polyhedrons.

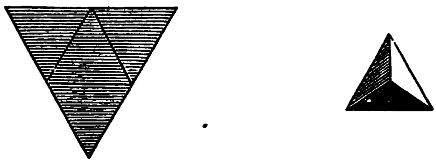
There are five solids, in each of which the faces are all equal polygons, and the solid angles of which are equal.

By knowing how to draw an equilateral triangle, the

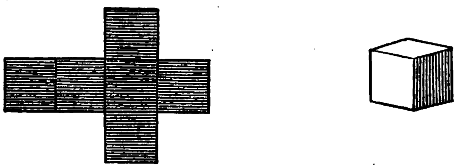
square, and the pentagon, as already described, each of these solids may easily be made of pasteboard.

Having drawn the figures as we have given them, on pasteboard, and cut them out accurately through their boundary lines, cut the other lines half through the pasteboard, turn up the parts and glue them together, and the forms of the solids will be obtained.

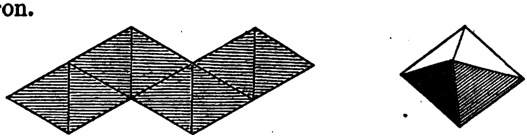
1. The *Tetrahedron*, or equilateral pyramid, is a solid bounded by four equal and equilateral triangles.



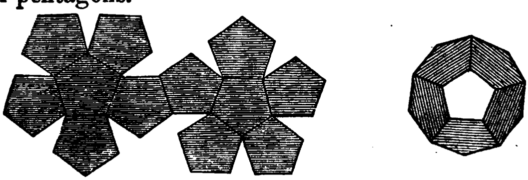
2. The *Hexahedron*, or *cube*, is a solid bounded by six equal squares.



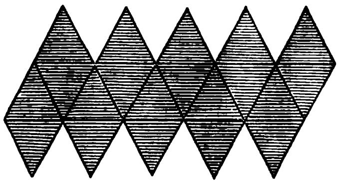
3. An *Octahedron* is a solid bounded by eight similar triangular faces. The triangles may be either isosceles or equilateral. The latter give what is called a *regular* octahedron.

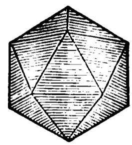


4. A regular *Dodecahedron* is a solid bounded by twelve equal pentagons.



5. A regular *Icosahedron* is a solid bounded by twenty equilateral triangles.





Let the pupil construct, out of pasteboard, a *pentagonal prism;* that is, a prism having a pentagon for each end, and equal parallelograms for the five sides.

PART III. LINEAR PERSPECTIVE.*

I. We early learn by observation that if two similar objects of the same size be placed at unequal distances from us, and in similar positions, the more distant object will *appear to the eye* the smaller of the two. Thus, if one post six feet high be placed fifty feet from the eye, and another post of the same height be placed one hundred feet from the eye, the more distant post will appear to the eye—the eye alone being judge—to be much shorter than the nearer post; and if we make a drawing of them in a picture, we must represent them, as nearly as possible, *just as they appear.* So of all objects that may be seen at one view: their appearance varies according to form, position, color, and distance; and perspective drawing, when combined with painting, is the art of so representing objects on a plane surface that the drawing or painting shall present to the eye *the same appearance as is presented by the objects themselves.*†

* PERSPECTIVE is treated of by writers under the two heads, *Linear Perspective* and *Aërial Perspective.* The former regards only the positions, magnitudes, and forms of the objects delineated; the latter treats of the variations in the degrees of light, color, and shade of objects, as affected by their greater or less distance from the spectator. The softening of objects in the distance, and their boldness of outline and coloring in the foreground, belong, therefore, to *aërial* perspective. In this article we treat of *linear* perspective only.

† To speak with strict accuracy, however, no picture can produce on

The plane surface, whether it be paper or any other substance, on which we make a drawing, is called the PERSPECTIVE PLANE; and it is supposed to be generally placed upright, or in a vertical position, between the eye and the objects represented on it.* A plate of glass, through which we should look at the objects, would very appropriately represent the perspective plane.

Perspective drawing is highly useful to enable us to give faithful representations of objects wherever photography can not be employed; and it will always be useful to architects and engineers, by enabling them to make correct drawings of intended buildings or machines.

II. In order to give pupils some clear ideas of linear perspective, endeavor to impress them with the truth that an object appears smaller the farther it is removed from the eye. Therefore, of two upright posts of the same height, the one that is farthest removed from the eye will appear the shortest. Now suppose a pupil stood in a position to see one side and one end of a large building. It could then see the position and length of three of the corner posts of the building, all of which are of the same height. Suppose the nearer corner post to be fifty feet from the eye, the corner on the left to be eighty feet distant, and the corner on the right to be one hundred feet distant. How would they respectively appear to the eye? Which would *appear* to be the longest? Which the next in length? Which the shortest? How, then, must they be represented in an accurate drawing?

Now call their attention to two drawings of the same

the eye *exactly* the same effect which the object itself produces, because the former being near, and the latter distant, the adjustment of the eye to distant vision is not the same in both cases.

* To speak more accurately, however, it is supposed to be so placed that the line from the eye to the centre of the objects shall be *perpendicular* to the perspective plane. If, therefore, the objects of which we make a drawing are directly *above* us, so that we look upward at them, the perspective plane will be in a *horizontal* position. But as most objects of which drawings are made are on the level of the eye, the perspective plane on which they are drawn must be in a vertical position.

building on the Chart, Fig. 1 and Fig. 2. In Fig. 2 all lines of equal length in Nature are *represented* of equal length in the drawing, without regard to the effects produced by differences of distance. Thus the three corner posts, which are of equal length in the real building, are made of the same length in the drawing. So the more distant rafter on the right is made of the same length as the nearer one, and the ridge of the building is made of the same length as the plate at the eaves. Now call their attention to another drawing of the same building, at Fig. 1, in which lines that are equal in Nature are made unequal in the drawing, being graduated according to the differences of distance. Thus the *nearer* corner post, 1 2, is made longer than the *more distant* posts, 3 4 and 5 6. Ask them which building appears the most natural. It will probably be found that Nature has already taught them to recognize the forms in which she *appears* to them, and that they will give their approval to Fig. 1.

Let them look at Fig. 1, and observe that all lines that are *parallel* in the *real* building tend toward the *same point* —that is, that they are not made parallel in the drawing, but *converge* in some one direction. Thus, if the several parallel horizontal lines on the end of the building were extended to the left, they would *all* meet at the point A; and if those on the side, and the one on the ridge, and the one at the top of the chimney, etc., were extended to the right, they would meet at the point B. A and B are called VANISHING POINTS, because certain lines vanish or terminate at these points.

Ask the pupils if they were standing on the floor of one end of a long gallery, and looking down the length of it, at which end of the gallery would the floor *appear* the narrowest and the gallery the narrowest. If the horizontal and parallel lines on the sides of the floor were to be represented in a drawing, therefore, they must have a *vanishing point.*

If the pupils were standing on a rail-road track, how would the parallel rails appear at a distance? The track

would seem to grow narrow in the distance, and should be so represented in a drawing; and the lines representing the rails should be drawn toward some vanishing point. So in Fig. 8, the numerous parallel lines in the marbled floor are seen to converge in the distance—all of them being directed toward the point C.

A VANISHING POINT, therefore, is that point in space toward which any two or more parallel lines *seem* to converge. It is important to remember that *all parallel lines have the same vanishing point.*

III. We see objects by the rays of light which come from them in straight lines to the eye.* If we look through a pane of glass at a building in the distance, and then mark on the glass the points through which the rays of light pass in coming from all the corners and angles of the building to the eye, and then connect these points properly by lines, we shall have an accurate outline drawing of the building, just as it appears to the eye at the particular point from which it is viewed. If we change the position of the point of view, or *point of sight*, the object will be changed in appearance; so that a drawing of an object from any one point of sight must differ from a drawing made from any other point.

[Place a book, or other object, on the table, and let pupils view it from different positions, and tell the changes of appearance caused thereby.

Let them view the school building, or some other building, from different localities (points of sight), and tell what parts of the building would be shown in the drawings made from different points.

Suppose they were making a drawing of a landscape which contained a lake. If the lake were *above* the level of the eye, would they represent the water in the drawing? When, only, could they represent a lake, river, etc., in a drawing?]

The POINT OF SIGHT, when used with reference to a drawing, or picture, is the point from which the eye is supposed to view the objects represented. If a line be drawn from the point of sight perpendicular to the perspective plane, the point at which this line intersects the

* In straight lines, except as they are deflected by the different media through which they pass.

perspective plane is called the CENTRE OF THE PICTURE. It will also intersect this plane, if the latter be in a vertical position, at the exact *height of the eye.* A line drawn horizontally through the centre of the picture is called the HORIZONTAL LINE; and all lines that are horizontal in nature have their vanishing points in this line.

IV. We are now prepared, with this preliminary knowledge of what is meant by the PERSPECTIVE PLANE, a VANISHING POINT, the POINT OF SIGHT, the CENTRE OF THE PICTURE, and the HORIZONTAL LINE, to proceed to a practical illustration of all of them in one drawing, Fig. **3.**

Suppose the colored parallelogram *abdc* to represent the ground plan, or base, of a building 25 feet wide and 50 feet long. Suppose the eye, that is looking at the building, to be placed at E, 50 feet from the nearest corner, and *on a level with the base of the building.* E is therefore the POINT OF SIGHT. Suppose a transparent plate of glass to be placed upright, in a vertical position, between the eye and the building, and in the direction of the line AB, and that it is designed to make a drawing of the building on this plate of glass. This plate of glass, then, represents the PERSPECTIVE PLANE. Draw a horizontal line, EB, parallel to the side of the building *cd;* and another horizontal line, EA, parallel to the end of the building *ca.*

Now it is evident that, in looking from E at *acd*, the three visible lower corners of the building, these corners will be seen, respectively, on the perspective plane, at the points 5, 4, and 7; for these are the points at which the rays of light from the three corners pierce the perspective plane in coming to the eye. If now we draw a line from E perpendicular to the perspective plane, to the point C, this latter point will be the CENTRE OF THE PICTURE; that is, it will be the point of most direct vision, where objects will be the most distinctly seen in a general view that takes in the whole picture.

If we could look through the vertical plate of glass—the perspective plane—and see the top of the corner post which stands at *c*, we could mark on the glass the appar-

ent *height* of this post. We will represent this height by the line 4 2. Now draw a line from 2 to B, and another from 2 to A; the other two visible posts of the building must be found, in the drawing, the one in the line 2B, and the other in the line 2A, as we have represented them at 6 and 3. The three posts will also be represented of their *apparent* relative height; the nearest by 2 4, the next in distance by 3 5, and the most distant by 6 7.

Now let the pupils tell *why* the corner 2 4 must be made higher than either of the other corners 6 7 or 3 5. Remember that E represents the place of the *eye;* and that the nearest corner of the building is supposed to stand at *c*, and the other two visible corners at *d* and *a*. Which of the three is the most distant from the eye? Why must the line 4 7, which represents one of the *sills* of the building, and 2 6, which represents one of the plates, and 1 8, which represents the ridge-pole, all tend in the direction of B? Because they are *parallel* in the real building; and all parallel lines have the same vanishing point.

But here it may be asked, how do we find the vanishing point of any given line; that is, how do we know in what direction to draw it? The unvarying rule is this: Draw a line from the point of sight (the eye) parallel to the given line, and where this drawn line pierces the perspective plane, there will be the vanishing point of the given line. Thus, in Fig. 3, having placed the perspective plane in a vertical position, and in the direction of the line AB, suppose we wish to find the vanishing point of the line *ca*. From the point of sight E we draw the line EA parallel to *ca*, and as the line thus drawn pierces the perspective plane at A, therefore A is the vanishing point of the line *ca*. It must also, necessarily, be the vanishing point of all lines that are parallel to *ca*. Therefore, not only 4 5 (which represents *ca*), but also 2 3, must tend toward the point A. Upon the same principles B is the vanishing point of *cd*, and also of all lines that are parallel to *cd*. Following out the same rule, N is found to be the vanishing point of the lines represented by 2 1 and 6 8.

It will also be seen that the nearer the eye is to the building which is to be drawn, the closer together will be the vanishing points AB, and, consequently, the more abruptly will such lines as 2 3 and 2 6 incline to their vanishing points. On the other hand, the farther the eye is removed, the farther apart will the vanishing points be removed also, and the less suddenly will the parallel lines converge toward them.

Now accustom the pupils to look at various lines in real buildings, and, on the supposition that they are to make drawings of these lines on a transparent plane placed upright between themselves and the objects, let them point out the *vanishing points* toward which the several lines would tend. They can do this by placing one end of a ruler or straight stick at the eye, and then holding it so that it shall be parallel to the given line. It will then be directed toward a point on the supposed perspective plane which will be the *vanishing point* of the given line, if said line is to be represented by a drawing on the perspective plane. Let the pupils notice, also, the different effects produced on the apparent direction of these lines both by *near* views and also by *distant* views of the same building. Let them name or point out those lines in buildings which must have the same vanishing point, and tell in which direction they vanish—to the right or to the left.

Now it will be apparent, in accordance with the rule, that the lines of the rafters 2 1 and 6 8 in Fig. 3 must have the *same* vanishing point. Why do not 2 1 and 6 8 vanish *downward* instead of *upward?* Because the ridge-pole, 1 8, being farther from the eye than the plate 2 6, appears the shorter; and this causes 1 8 and 8 6 to seem to converge upward. They in reality seem to converge—that is, to come to a point—at N, directly above A. If the roof of the building were steeper than it is, the point N would be higher; if the roof were flatter—that is, had less pitch—the vanishing point N would be lower; but, in any event, it would be directly above A. The line 1 3 must tend in the direction of a point just as far below A as N is above

it; and this rule gives us the true position of the line 3 1.

[The pupils should now, with the aid of a ruler, make drawings similar to Fig. 3, first on their slates and on the blackboard, and afterward on paper with a sharp-pointed and hard pencil.. In making the drawing, first lay down the ground plan *abdc;* next take the point of sight E; then draw EB parallel to *cd*, and from E draw EA *at right angles* to EB and parallel to *ca*. Draw next the lines representing the outermost rays of light that come from the object viewed to the eye, and on these two lines take E5 and E7, of equal length; and the points 5 and 7 will give the proper direction of the horizontal line, on which, in Fig. 3, is supposed to be placed the perspective plane. Complete the drawing according to the principles and rules already given. Make other drawings similar to this, but changing the point of sight to the right or to the left, or placing it nearer or farther off, etc. The horizontal line and perspective plane may be supposed to be placed nearer the eye or more distant from it, thereby varying the *size* of the drawing.]

IV. We may now return to Fig. 1, for the purpose of illustrating some new principles.

In this case the horizontal line AB (and, consequently, the height of the eye) is *above* the base of the building. We may obtain the relative proportions of the visible width of the end 9 7 and of the side 9 8 in the same manner that we obtained the points 5, 4, and 7 in Fig. 3, by laying down the ground plan, and taking the position of the eye, etc.; or we may draw the horizontal line AB according to our judgment; and, judging likewise by the eye, we may mark off on it the relative positions of the three visible corners of the building, 9, 7, and 8.

Suppose the outlines of the building to be completed, as in Fig. 3. We now wish to put in the *windows*, and have them of their relative perspective height and width. We will suppose, in this case, that the bottom line of the windows is at the exact height of the eye. The horizontal line will therefore be the guide in this direction. For their height, we mark off on the corner line a space above 7, according to the true proportion which the height of the windows bears to the whole line 2 1, and draw a line to B. This gives us the upper line of the windows.

To obtain their relative perspective *width* and *positions*, we draw from the upper corner, 1, a line, 1P, parallel to

7 8, and in it take any point, P, so that 1P shall be greater than 7 8, and so that a line drawn from P through the corner 5 shall strike the horizontal line at O, any where between 7 and 8. The line 1P is now supposed to represent the length of the side of the building; and it is laid off in divisions representing the *real* width of the windows and of the spaces between them. Thus, suppose the distance from the corner 1 2 to the nearest window is four feet, and that each window is four feet wide, and that each intervening space is also four feet wide. Then 1P will be laid off in nine equal divisions, four of them representing the windows, and five of them the other spaces. From all the points *a*, *b*, *c*, etc., draw lines toward O, and from the points where these lines intersect 1 5 draw vertical lines, and these will give the relative widths of the windows, spaces, etc., as shown in the drawing.

[Now accustom pupils to make separate drawings of the side of the building only, and to put in the windows, first according to the plan given in Fig. 1, and afterward with different plans which the teacher may give them. Let some of these plans require *two* rows of windows instead of one; let some have the intervening spaces twice the width of the windows, etc.]

The true perspective height and width of the large door in the end of the building may be obtained according to the method given for drawing the windows in the side of the building, by drawing a line from the upper corner, 1, to the left, parallel to 7 9, and marking off the proper spaces on this line, in the same that was done on 1P. Or another method may be employed: Draw the diagonals 1 4, 3 2. Their intersection at *s* will give the true perspective centre of the end of the building. If the door be in the *centre* of the end, and if a point be taken any where on 1 4 for one side of the door, the corresponding point on the other side of the door must be in the other diagonal, 3 2, and also in a line drawn through the first assumed point to the vanishing point A. It should be noticed here that the point *t*—the gable point—must always be in the line which is drawn vertically through the centre *s*.

[Pupils may now be accustomed to make drawings of the ends of buildings of different plans; first with one door, and in the centre; next with two doors, one on each side of the centre; next with doors and windows, according to plans which the teacher may give. The teacher should *describe* these plans, and not make drawings of them for the pupils to imitate. After a sufficient number of these separate drawings of the sides and ends, let the pupils combine the whole into drawings of complete buildings.]

V. In Fig. 4 is shown the ground plan of a square building, with a square projection, or tower, on each corner. The eye of the spectator is supposed to be some distance above the base of the building. The design of the drawing is to show how the perspective *widths* of the several parts visible from any point, such as E, may be obtained, for the purpose of using them in a drawing of the whole building. The point of the eye at E being assumed, the direction of the horizontal line, and the position of the vanishing points, one at A, and the other at the right of D (at some distance out of the picture), are then obtained, in the same manner as in Fig. 3. The relative perspective widths of *er*, *rp*, *pn*, *md*, *dk*, etc., are obtained on the horizontal line, at the points 7 6 5 4 2, etc. It will be observed that only *hi*, of the line *h*—, can be seen from the point of sight E, etc. Some little care will be required in drawing the various lines at the bottom of the building, below the eye; such as 9 8, 8*s*, *st*, etc. Here it will be important to keep in mind the rule, that all *parallel* lines have the *same* vanishing point. Thus, *re*, *np*, *dm*, and *fh*, vanish to the right, in the direction of D; and *rp*, *dk*, *ih*, and *fa*, have their vanishing point at A. Therefore, while 8 9, which represents *re*, must tend to the vanishing point to the right, 8*s*, which represents *rp*, must tend in the direction of A. Following the simple *rule*, it will be easy to make accurate drawings of almost every possible plan of building.

[The pupils should now make drawings of buildings having plans similar to Fig. 4. Let them take the ground plan of Fig. 4, and make a complete drawing of a building of that form, 20 feet high, and suppose the horizontal line to be five feet from the ground. To do this they should obtain the perspective widths of the different parts on a line, like AD, and then make the drawing on another paper.]

VI. Fig. 5 represents a view of three square blocks (not cubes) placed one upon another, and each upper block less in area than the one below it, the whole surmounted by a pyramidal block, the top, or apex, of which rises to the exact height of the eye. Here the eye is supposed to have the same extent of view of each of the two visible sides, and therefore DF is made equal to DE. Practice in making a drawing of Fig. 5 will be worth more to the pupil than directions by us. In placing the second block upon the first, be careful to have the *corners* placed exactly upon the diagonals of the lower block. In this way each upper block and the pyramid are placed *centrally* upon the block below it.

[Let the pupils make drawings similar to Fig. 5, having each succeeding block smaller in area than the one on which it rests, and placed centrally upon it.

Draw a gradually diminishing series, like Fig. 5, extending up to the horizontal line; then place upon this an inverted similar series, so as to show the *under side* of the projecting parts of the blocks.

Let the teacher suppose the blocks placed in some different positions; for example, the faces on one side all in the same vertical plane; and then again, some of the blocks projecting over on one side.

There is no end to the variety of plans which the teacher may design. Let the teacher place square blocks of wood (books may answer) on the table, or on the floor, variously arranged upon each other, and require pupils to make drawings of them from different positions. They will need to pay particular attention to the horizontal line, centre of the picture, and vanishing points.

Let the pupils point out, with a pointer, and fully explain, not only the diagram, Fig. 5, but also the drawings which they themselves have made.]

Figures 6 and 7 are here supposed to form parts of one picture or drawing. The eye is supposed to be intermediate between them, and, as in Fig. 5, at the height of the horizontal line, and in a line that is perpendicular to the perspective plane at C.

In these two drawings, and also in Fig. 5, the eye is supposed to be as far from the centre of the picture, C, as the vanishing points A and B are on each side of it. In Fig. 6 and Fig. 7, the blocks are *oblong* and rectangular; that is, the sides represented by DE in both figures are greater than those represented by DF; and the line 3 2 of the

pyramid represents a side greater in extent than 3I. The side represented by DE is, indeed, *nearly one third longer* than that represented by DF, although to an unpracticed eye it may not *appear* any longer.

If we had wished to represent the blocks as *square* in Fig. 6, we should have drawn a diagonal line from F to the vanishing point B; and the point where FB intersected DC would have been the true perspective position for the corner E. To represent the block as *square*, therefore, the corner E must be removed about half an inch nearer the corner D. Let it be borne in mind, therefore, that Figures 6 and 7 do *not* represent *square* blocks, but *oblong* rectangular blocks. A drawing of a pyramid standing on a *square* base, and on *square* blocks, would present handsomer proportions than the drawings we have given.*

It will be noticed that the horizontal lines on one side of the blocks, both in Figures 6 and 7, are made *horizontal* in the drawing. Thus DF, JK, 8 6, etc., in both figures, are drawn horizontally, unlike the corresponding lines in Fig. 5. This is what is called *parallel* perspective, and is really a slight misrepresentation of the actual appearance of the lines represented; for in reality the lines represented by DF, GR, 8 6, etc., in Fig. 6, have the appearance of converging toward a vanishing point on the horizontal line at a considerable distance to the left of A. The corresponding lines in Fig. 7 would likewise seem to be directed toward a vanishing point to the right of B. But when two structures are situated as those represented by Figures 6 and 7 are, with reference to the spectator, those horizontal lines which are parallel to the perspective plane are usually

* All horizontal lines which make angles of 45 degrees with the perspective plane are called *diagonals;* and the vanishing points of these diagonals are on the principal horizontal line, at the same distance, one to the right and the other to the left, from the centre of the picture that the point of sight is distant from the centre of the picture. Hence it is easy to find where must be the vanishing points of the diagonals of the horizontal base of a square; and the intersections of these diagonals with other lines are aids in finding other important points in the drawing.

made horizontal in the drawing, as they are in this case, because they vary but slightly in appearance from being in a horizontal position, because it is easiest to draw them horizontally, and because our impressions of their being actually in a horizontal position are strong enough to counterbalance the very slight error of their variance from a truthful representation. If the Chart be placed in a vertical position, and the eye be removed ten feet back from it, the difference between the distance of GD from the eye and HF from the eye will be so small as to be scarcely appreciable; and hence all such lines as GH and DF (Fig. 7) may be drawn horizontally and parallel to each other—in *parallel perspective.*

Let it be observed that the lines DE, JL, 8 7, 3 2, etc., in both drawings (Figures 6 and 7), have their vanishing point at C, the centre of the picture. Now these lines are in Nature perpendicular to the perspective plane; and they exemplify the important rule that *All horizontal lines that are perpendicular to the perspective plane have their vanishing point at the Centre of the Picture.* Therefore, if a person were standing at one end of a long room or gallery, and looking down the length of it, all the horizontal lines that run from him (perpendicular to the perspective plane on which we may suppose he is to make a drawing of the gallery) would seem to tend to a point on the perspective plane that is just at the height of his eye—that is, the Centre of the Picture. This principle is well illustrated in Fig. 8.

Fig. 7 shows by the dotted lines on the upper surface of the upper block, how to obtain the exact position of the apex, Y. The diagonals 7 6 and B 5 must give, at their intersection, O, the perspective centre of the upper surface of the upper block. It is evident, therefore, that Y must be directly vertical to O.

[1. Let the pupils now make drawings like Figures 6 and 7.

2. Let them make similar drawings, but representing the blocks as *square* on the base, and also as complete cubes. Some little study of the *diagonals* already referred to in the note on the preceding page may be needed to accomplish this.

3. Let them make other similar drawings from plans of their own, or from such plans as may be given them by the teacher.

4. Let them also *explain* all as they would problems in geometry.

5. Place the pupil at the centre of and fronting one end of a table, and place blocks of books on the table, and square with it, on his right and on his left, and let him point out the vanishing point of all the lines representing the edges of the books that are parallel with the sides of the table. Let him also make drawings of these blocks of books.]

VI. Fig. 8 represents a view of two rows of square pillars or pilasters, five in a row, and standing in two parallel lines that are perpendicular to the perspective plane. The pillars are supposed to be at equal distances apart in each row; and the distance between any two pillars is supposed to be double the thickness of a pillar.

The pillars are supposed to stand on a tesselated marble pavement, formed of rows of alternating square blocks of light and dark marble, and these rows in one direction are parallel with the two rows of pillars. The spectator is supposed to stand centrally in front, so that a line from his eye perpendicular to the perspective plane shall strike the plane at C, the Centre of the Picture. Hence, according to the rule previously given, all lines that are perpendicular to the perspective plane, such as IC, JC, HC, GC, etc., must have their vanishing point at C. The beautiful effect produced by such a drawing will be most apparent by looking through a tube that shall just embrace the entire drawing. A roll of paper, or the hand partially closed, will make a very good tube for this purpose.

The pillars in Fig. 8 are drawn in parallel perspective; that is, such lines as IK, GL, PJ, RH, are drawn horizontally, and parallel with each other. They have no vanishing points.

The most important thing connected with Fig. 8 is to learn how to draw the pillars at equal *perspective* distances apart, and so that they shall also diminish in thickness in true perspective; while the marble blocks are also made to conform to the same laws. All this, however, is very easily done, on the principle of putting in the windows in Fig. 1.

Having drawn the corner line of one of the nearest pillars, IG, according to your judgment, draw a line DF parallel with the horizontal line AB. In this line take any point 1, so that a line drawn from 1, through the corner G, shall strike the horizontal line at O, somewhere to the left of IG. Now mark off, to the left of 1, spaces that shall represent the true thickness of the pillars, and the spaces between the pillars. Thus, if the pillars be *one* foot in thickness, and the distances between the pillars be *two* feet in thickness, mark off 1 2 for the thickness of the first pillar; make 2 3 double the distance of 1 2, for the space between the first two pillars; make 3 4 equal to 1 2, for the thickness of the second pillar; make 4 5 equal to 2 3, for the distance between the second and third pillars; and so continue for as many pillars as you design to put in. Then draw lines from 1, 2, 3, 4, 5, 6, etc., to the point O, and the intersection of these lines with the line GC will give the points or positions of the lower corners of the pillars, and, consequently, the distances between the pillars. The same points give the true perspective positions of the lines which designate the rows of marble blocks that run *across* from one line of pillars to the other, with the exception of those lines that run from points half way between the pillars. These latter points are obtained by drawing lines from points half way between 2 3, 4 5, etc., to O. Their intersections with GC will give the true intermediate points.

The pillars on the left are drawn in the same manner as those on the right, beginning with the corner HJ, which is here supposed to be at the same distance to the *left* of the spectator as GI is to the *right*. The pillars on the left, however, are easily placed in position, with their proper widths, by drawing horizontal lines from the corners of the pillars on the right.

[Pupils should now make drawings similar to Fig. 8. They may also represent uniform pieces of timber—lintels—thrown across from each pillar on the right to its corresponding pillar on the left. This, if neatly done, will be found to give increased effect to the perspective. They may also take the centre of the picture (C) farther to the right, or farther to the left. They may also draw *four* rows of pillars, making the pillars

narrower, so that the eye may look between them, and see the outer rows. They may also make the *inner* rows less in height than the outer rows, so that the outer rows may be seen to rise above the others.]

VII. Fig. **9** shows the perspective of the casings of a deep window. The eye is supposed to be in a line perpendicular to the vertical plane of the window at C. This drawing gives the *relative* perspective widths of the casings, and the perspective of the lines 1 4, 2 3, 8 5, and 7 6.

Fig. **10** shows the manner of finding the perspective of any vertical divisions on a circular tower. Draw the line 1 8 of the length which you intend for the width of the drawing of the tower. On 1 8 describe a semicircle; then divide this semicircle in strict accordance with the divisions on the visible part of the tower, and from the points of division on the semicircle draw lines vertically downward to 1 8. The divisions of 1 8 will give the perspective of the divisions required on the tower.

In the foregoing explanations, aided by the illustrations on the Chart, we have set forth, in as plain and practical a manner as possible, all the important *principles* of Linear Perspective. It requires no special knowledge of any of the higher branches to understand these principles, and to apply them to almost every imaginable kind of structure; and we think that any intelligent pupil of 12 or 14 years of age can easily master this whole subject.

Written Compositions.

Although we have given but little more than an outline sketch of the three great departments of DRAWING, and have not been able to touch upon the principles and effects of due proportions of *light* and *shade* in a picture, yet sufficient has been presented to furnish suggestions for a series of compositions upon the general subject.

Under the head of the first division may be explained the proper mode of making the outline sketches from pictures, and from nature, with descriptions of uncolored en-

gravings, and of views of objects in nature, natural scenery, etc. The object should be to lead pupils to observe engravings carefully—to notice what parts are supposed to be near, and what distant, and how they are represented as to boldness or faintness of outline and shading, and the disposition of light and shade, etc.

Under the second division let pupils refer to objects in nature or in art that correspond, in whole or in part, with any of the geometrical figures on the Chart. For example, let them examine the cell of the common honey-bee, and tell its form (hexagonal), and give reasons for its being of that form. Let them show what the principles of "Construction" have to do with the planning and manufacture of all kinds of fabrics, tools, instruments, weapons, etc.; and, more especially, in the erection of dwellings, and buildings of all kinds. Show their connection with *Architecture*. The more advanced pupils may carry out some of these geometrical problems in their applications to the measurement of lands, and other surfaces, the calculation of distances, etc.

Under the third head they may explain the general principles of Perspective, and some of their applications to views of buildings. Let them take large drawings or engravings which represent buildings, and show how the principles of perspective apply to them—telling where the point of sight is supposed to be, where the horizontal line is, and where are the vanishing points of the various lines, etc. In most engravings of buildings they will be able to detect some errors of perspective.

CHART No. XI. LINES AND MEASURES.

The directions given in Calkins' "Primary Object Lessons" for developing ideas of lines, measures, angles, radius, circle, circumference, etc., render it unnecessary for us to take up the subject in its earlier lessons. A few def-

initions only will be necessary here, as guides to the teacher in his explanations.

Vertical Straight Lines are such as point to the centre of the earth. If a plummet or other weight be suspended by a string, the string will be in a *vertical* position. Name lines that are vertical.

Parallel Lines, which may be either straight or curved, are equally distant from each other in all their parts. Are the opposite vertical sides of a building parallel? Not exactly. Why not?

A **Perpendicular Line** is spoken of only with reference to some other line. Thus a straight line is perpendicular to another straight line when it makes the two adjacent angles equal to one another. Each of these angles is called a *right angle* (see Chart). But if two straight lines meet each other so as to make but *one* right angle, each is said, in this case also, to be perpendicular to the other (see Chart). Perpendicular lines may therefore be vertical, horizontal, or oblique.

Let pupils, from their own investigation, distinguish between an *arc*, a *chord*, a *radius*, and a *diameter*; and between a *circle* and a *circumference*. (The latter two terms are sometimes used as synonymous.)

Concentric Circles are circles that have a common centre.

An **Ellipse** (see page 61, and Chart No. X.) is such a curve that the *sum* of the distances of *any* point in it from the two *foci* is equal to a given line. This is best illustrated by the method of drawing an ellipse as already described. The greater diameter of the ellipse, which passes through the two foci, is called the *transverse diameter*, or *major axis*. The lesser diameter, which bisects the former perpendicularly, is called the *conjugate diameter*, or *minor axis*.

Measures.—Children should be accustomed to judge by the eye of the circumference and diameter of circles. For this purpose, let them draw circles on the blackboard. By using a wooden rule containing inches and its divisions, which every school should be provided with, they will be able to verify their judgment. They can easily measure the diameter of a circle; but it will not be so easy to measure the circumference. They should know, therefore, that the circumference of any circle is a *little more* than *three times* its diameter. Having this rule, they can judge very nearly of the circumference after they have measured its diameter.*

* The circumference of a circle is 3.1416 times its diameter, or a little more than three and one tenth times the diameter. Having the di-

Let pupils be accustomed to estimate the number of square inches in the surfaces of strips of boards, tables, benches, etc.; also the number of square feet in boards, the tops of tables, the floor, the end or side of the room, etc. Do not give them cases of *parts* of inches or *parts* of feet to estimate until they have become perfectly familiar with the principle. They should learn, from simple illustrations, that the number of square inches in a board, etc., is obtained by multiplying the length by the breadth.

Degrees of Circles.—Teach pupils that learned men have agreed that every circle, whether it be a large or a small circle, shall be considered as divided into 360 equal parts, which are called *degrees*. Thus, on the Chart are two circles, the circumference of one inclosing the circumference of the other; but both have the same number of divisions or degrees. A quarter of a circle, therefore, contains 90 degrees, and half a circle contains 180 degrees.

What kind of an angle do 90 degrees form? Less than 90 degrees? More than 90, and less than 180?

Elevation.—Astronomers often speak of angles of elevation. Elevation has reference to the angular height of an object above the horizon; that is, above a *horizontal* line. Thus, if a star is said to be at an elevation of 45 degrees, it is one half of the distance from the horizon to the zenith.

Inclination, in astronomy, has reference to the angle which one line or one plane makes with another, in whatever positions they may be. Thus, in the figure on the Chart ("Inclination"), the first line at the left of the vertical line has an *inclination* to the vertical line of 15 degrees; that is, it is separated from it by an angle of 15 degrees; the second line has an inclination to it of 23½ degrees; the third, of 45 degrees, etc. The fourth line has an inclination of 75 degrees to the vertical line, and of 15 degrees to the horizontal line.

The *inclination* of the magnetic needle is measured or denoted by the angle which the needle makes with the horizontal plane. In the northern hemisphere generally, the north pole of the needle dips *below* the horizontal plane, and hence makes an angle with it, which angle denotes the *inclination* of the needle.*

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ameter of a circle given, multiply 3.1416 by the diameter, and the product will be the circumference.

* The plane of the earth's equator makes an angle of 23° 28′ with the plane of the earth's orbit, usually called *the plane of the ecliptic;* hence "the *inclination* of the plane of the earth's equator to the plane of

FIRST PRINCIPLES IN GEOGRAPHY.*

First Lesson. Direction of Objects from a given Point.

Teacher stands at his desk, or some other suitable place, and asks in *what direction* the stove (or such other object as he may select) is from him? (North, or, as the case may be.) In what direction is the door? In what direction do I point with my right hand? With my left hand? In what direction from me is William? James? In what direction is Mr. A.'s house? Mr. B.'s house? Mr. W.'s house? etc. In this manner let the points of the compass, from some one stand-point, be thoroughly learned.

Second Lesson. Distance and Direction from a given Point.

Teacher stands at his desk, or other suitable place, and asks the distances and directions from him of the four corners of the room. The distance and direction of the stove from me? "It is about eighteen feet southwest from you." Very well: the distance and direction of that window from me? Of the door? Of John Brown? etc., etc. If there is any doubt about the correctness of any of the answers, the pupils should measure the distances.

Third Lesson. Distance and Absolute Locality.

I wish you to tell me about *how far* from the teacher's

the ecliptic is 23° 28′." In Webster's large dictionary it is erroneously stated, under the word "inclination," that "the inclination of the *axis* of the earth to the plane of the ecliptic is 23° 28′." On the contrary, its axis inclines 23° 28′ from a line *perpendicular* to the plane of the ecliptic, and 66° 32′ from the plane of the *ecliptic itself*.

The earth and all the planets move round the earth from west to east, in orbits which are not exactly in the same plane, but *inclined* to one another by small angles. Their *inclination* is computed by considering the plane of the earth's orbit as a standard, and calculating the angle which the plane of each other planetary orbit makes with the plane of the earth's orbit.

* For primary exercises in "developing ideas of place," and establishing first principles in geography, see Calkins' Object Lessons, pages 242–268; Dr. Hooker's Primary Geography; Colton's Geographical Cards.

desk John Brown is, and in *what part* of the room. "He is about forty-five feet from the teacher's desk, and in the southwest corner of the room." The same of other boys. In the same manner you may describe the situation of this chair which I place here. "The chair is about sixteen feet south from the teacher's desk, and a little east of the centre of the room." So of other objects in the room—doors, windows, stove, desks, etc.

Fourth Lesson. Distance, and Comparative or Relative Locality.

I wish you to tell me *how far*, and in *what direction*, the stove is from me. "About twelve feet *south* from you." (Teacher now changes his position to the other side of the stove, and repeats the question.) "The stove is now about twenty feet *north* from you." How far is John from William, and in what direction? William from John? James from Rufus? Rufus from James? Thomas from Rufus? Rufus from me? The door from the stove? etc. Continue in this manner until the pupils are familiar with distances and relative localities in the school-room.

Fifth Lesson. Distances, Directions, and Localities, represented by Map-drawing.

Teacher says, "John, I wish you to make a drawing on the blackboard, that shall *represent* the *floor* of this school-room, with its desks, seats, stoves, etc. We will call the upper part of the board *north*, the lower *south*, the right hand *east*, and the left hand *west*. You may make the drawing to the scale of *one inch* to the *foot;* that is, you may let one inch in the drawing represent a foot in the school-room." The teacher may now draw the scale himself (say thirty or forty inches) on the blackboard, and draw the line for the north end of the room, and then leave the pupil to complete the drawing, aiding him by suggestions in the way of *questions*, if it should be necessary. Open spaces should be left in the outer lines for the doors, and dotted spaces for the windows. If the plan of the

school-room is at all intricate, the seats or desks should not be drawn in separately at first, but merely the spaces marked off for their principal *groups*. Let the pupil *measure* all the distances, and then *adapt* them to the scale, after having first *guessed* them. When the drawing is completed, the pupils should be told that this is a MAP of the school-room. Several days will probably be occupied in making it.

Subsequent Lessons.

After one drawing of the school-room has been made in this manner, in view of the class, or all the pupils, on some other day, while one pupil goes to the board and draws a similar map, unassisted, the others should be drawing maps of the same on their slates, with pencils that they should keep neatly pointed for drawing purposes. Although these first efforts may be exceedingly rude, yet their very rudeness will be the exact *measure* of the pupil's capacity, which the teacher needs to understand, as a guide to his instructions. The more rude these first sketches, the more obstacles will the pupils have to overcome; but it is *in overcoming just such natural obstacles* that the pupil receives that NATURAL *educational discipline* which he requires. Never place artificial obstacles in his way; but help him as little as possible (except by such suggestions as will call forth his own powers) in overcoming those which Nature has provided for the purpose of discipline. It may be a week, or month, or longer period, before *any* of the pupils can make a fair map of the school-room, so many things will be done wrong at first; but when a pupil can draw such a map well, he can draw a map of *any thing else* with which he is acquainted; and in the mean time he will have received an amount of self-imposed discipline, whose value can hardly be overestimated. After a time he may be allowed to make his map on paper, with a pencil.

After a fair map of the school-room has been provided, on the blackboard, as herein designated, the pupils should

from time to time point out and describe the various localities, distances, etc., there represented, *going over the substance, generally, of the preceding four lessons.*

The pupils having become familiarized with this *descriptive* geography, their attention should next be called to the government and exercises of the school-room—to that which corresponds to the *political* geography of nations. Thus the school is an assemblage of pupils for the purposes of education; the teacher is its governor or ruler; the *need* of some one to *govern*, as well as to instruct, should be elicited by questions; the *principles* on which he should govern (those of family government) should be called forth in the same manner, together with the rules of *right* and *duty*, which pupils are bound to obey. They should also describe the daily routine of exercises in the school-room, the classes, what each class studies, time given to recitation, time of opening and closing school, etc. Thus this microcosm, or world in miniature, may be made the type of that national life which constitutes one of the higher departments of learning.

Tell the pupils how many feet make a rod, how many rods make a quarter of a mile, how many quarters of a mile make a half a mile, and how many half miles make a mile. When they understand this, ask them, "How many feet or how many rods long is this building? How many rods across the yard in which the building is situated, from east to west? From north to south? Across the street?" etc. Let them *measure* these distances after having guessed them.

Next name different localities in the neighborhood, such as the store, the hotel, Mr. M.'s house, Mr. B.'s house, a conspicuous tree, rock, or other landmark, etc., and require the pupils to tell their directions from the school-house and supposed distances. The teacher should go out with his pupils and measure some of these distances, which may then serve as a measure for other distances. Thus it may be *four rods* across the street, ten rods to the corner, and

eighty rods, or *a quarter of a mile*, to Mr. A.'s house. Having these distances well fixed in their minds, pupils will soon learn to judge of other distances. Such lessons will not only be a pleasant recreation, but a good mental discipline also, requiring constant exercise of the judgment in *comparing* and *measuring*. If well arranged and skillfully conducted by the teacher, they may also be made to require the use, unconsciously on the part of the pupils, of the four fundamental rules in arithmetic. Here, for example, is a distance of 25 rods; another of 15 rods; another equal to both of them: here is a distance of 40 rods, and another is 10 rods less; here is one of 80 rods, another the half of it, and another still a quarter of it. The extent, interest, variety, and intricacy of these exercises must depend wholly upon the teacher's invention and judgment. Will they not furnish *him* also some useful mental discipline, and call forth additional *tact* in instruction?

Let the teacher lead the pupils on, as in the preceding lessons, to draw on the blackboard and on their slates at first, and afterward, if he think best, on a large sheet of paper, a map of the neighborhood for a mile or two around the school building, laying down the roads, buildings, streams, woods, fenced fields, etc., and having the upper part of the map north. Then, with the school building for the point of observation, go through with the principles of all the preceding lessons under this geographical division. This should be done thoroughly, and may well occupy the class, or the school, fifteen minutes daily for at least a dozen lessons. *They will be learning, in this way, the rudiments of topographical engineering.*

Next, having completed a map of the neighborhood, with the roads, the buildings, the fields, the groves, the springs, the streams, the hills, the valleys, the woods, etc., place this map before the pupils, and question them, first on the topography, and afterward on the *Natural History* of the neighborhood—such as what fields are now used for grain, for pasture, for meadow, for summer fallow; what kinds

of grain are growing in certain fields; what flocks or herds are seen in others; what kinds of trees are found in the woods; what flowers and grass in the fields; what noxious weeds; what kinds of soil; what rocks or stones; what fishes in the streams; what birds are known in the country around; what wild animals; what the buildings are made of, whether of wood, brick, or stone; what kinds of wood are used; and what are the occupations of the inhabitants. Here are very suitable subjects for a series of *compositions.*

By this time the pupils will have learned the rudiments of Geography—*mathematical*, *political*, and *physical.* If the exercises have been skillfully conducted, they will not have deemed it a study, but a recreation; and they will be prepared to understand a map of the town, a map of the county, a map of the state, and a map of the United States —which should be taken up and studied *in the order here given.*

A *town map*, containing the roads, streams, etc., should be found in every school-room; and if the town has a just appreciation of the importance of geographical knowledge, and of the true mode of acquiring it, it will furnish such a map for every school, and deem it an economical expenditure. The teacher would, it is true, be compelled to supply much of the descriptive matter; but the pupils would now be able to understand and to appreciate it, from its similarity to what they themselves had furnished respecting their own neighborhood. Thus, step by step, would they proceed from the known to the unknown, and from particulars to generals, in the true inductive method, until they had embraced the geography of all the countries of the globe—their knowledge of things being less and less minute, as they diverge farther from the central point of *Home.* But this is the true order of importance, as it is the order which Nature has marked out for us. Things *near* are those which first and most concern us; they first arrest our attention; they most excite our sympathies; they are most nearly connected with all our interests;

they, indeed, almost fill our entire vision—standing up before us conspicuous in all the details of form and coloring; while the distant, little discerned, little thought of, having but few and feeble connections with us, either dwindles away in dim and shadowy outline, or entirely vanishes in obscurity.

How differently from the old system, then, should we teach geography to our children! *We* began the study, not *at home*, and by *observing* and describing familiar localities around us, but at as distant a point as possible, by being told that there are certain *planets* that revolve around the sun; that the *earth* is one of these planets; that it is a round globe or ball, and that it may be circumnavigated; certain great circles and certain smaller circles were then *described* to us in language mystical, and parallels of latitude and longitude, and zones; and after a long while we got a footing on *terra firma;* but, alas! we never got so near home as our native town, and the scenes of our childhood. In those days we never dreamed that what we knew about the fields, and the woods, and the streams, and the hills, and the valleys around us—all delightful knowledge, and to this day teeming with pleasant associations—had any thing to do with that dry and distasteful study which a certain school-book told us is "a description of the earth."

Composition.—The teacher will find suitable subjects for a *series* of written compositions in the foregoing exercises, as already suggested. These compositions should be carried on simultaneously with the pupil's progress; and what he can describe in words, he should be accustomed to put on paper. This matter of beginning *early* to write compositions upon the subjects *talked about* and studied, is highly important, and should on no account be neglected.

CHART No. XII. FORMS AND SOLIDS.

The chief object of this Chart is to lead pupils, *first*, to recognize and name the principal mathematical forms and solids, and *afterward* to describe them. Forms and solids of the same size as those represented here have been prepared, cut out of wood, and may be obtained either with or without the Charts.

It will be found that quite young pupils can learn to recognize these *objects* as easily as any others, if they can be made to take an interest in them. The lessons on this Chart, generally, should precede the "Geometrical Drawings" from Chart No. X. The mathematical *descriptions* should not be required until the pupils are perfectly familiar with both the *forms* shown on the Chart, and the *wooden blocks* also. For the first lessons for developing ideas of Form, see Calkins' Primary Object Lessons, pages 41–93.

I. 1. In the first exercises from this Chart we suggest that one pupil point out the first form (right-angled triangle), another select the same from the blocks, a third name it, and a fourth write its name on the blackboard, or set it up with the Letter-cards.

2. Go through with all the other forms and solids in a similar manner.

II. 1. Go through with all in the same manner as before, and, in addition, give a brief *description* or definition of each figure, and also draw on the board, or require the pupils to do it, different *forms* of the same figure, where they can be made to accord with the definition. Thus the right-angled triangle admits of a great variety of forms; so of all the figures in the second line, except the isosceles triangle. Let the pupils be particular to point out the *differences* between figures that somewhat resemble each other.

2. In connection with the foregoing, let the pupils name and describe objects that have forms similar to the blocks.

Definitions of Forms. See Chart.

A **Triangle** (see second row of figures on the Chart) is a plane* figure, which is bounded by three lines. Such figures are said to be *triangular*. If the lines are straight, the triangle is *rectilinear;* if they are curved, it is a curved, or *curvilinear* triangle, as in the fourth row on the Chart. A triangle may also be partly rectilinear, and partly curvilinear.

A **Right-angled triangle** is a triangle that has one right angle.†

A **Square** is a plane figure that has *four* equal sides, and four right angles.‡

A square is a *rectan'gular*, or right-angled figure.

A **Pentagon** is a plane figure that has *five* equal sides, and five equal angles.§

A *pentag'onal* figure.

A **Hexagon** has *six* equal sides, and six equal angles. *Hexag'onal.*

A **Heptagon** has *seven* equal sides, and seven equal angles. *Heptag'onal.*

An **Octagon** has *eight* equal sides, and eight equal angles. *Octag'onal.*

An **Isosceles triangle** is a triangle which has only two sides equal.

An **Equilateral triangle** is one that has all its sides equal.

A **Parallelogram** is a four-sided figure which has its opposite sides parallel, and consequently equal. In common use this word is applied to figures of more length than breadth.

A **Trapezium** is a four-sided (quadrilateral) figure, none of whose opposite sides are parallel.

A **Trapezoid** is a four-sided figure, having two of the opposite sides parallel.

A **Rhomb** is a four-sided figure whose sides are equal, and the opposite sides parallel; but it has two opposite and equal acute angles, and two opposite equal and obtuse angles.

A **Rhomboid** is a four-sided figure whose opposite sides and angles are equal; but neither are all its sides nor all its angles equal. *Rhomboid'al.*

An **Oval** figure may either be in the shape of an egg, or of an ellipse; but the term means, literally, *egg-shaped.*

An **Ellipse** is a figure formed by cutting a cone by a plane that passes obliquely through the opposite sides of the cone. It may also be formed in another manner, as described on page 61. *Ellip'tical.*

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* Tell them a *plane* (not *plain*) figure is an even, level, or flat *surface*, which has no *thickness*. They must understand, therefore, that it is only the flat *surface* of the blocks that constitute the "Forms" named and represented on the upper part of the Chart. The teacher must not allow pupils to make the mistake of supposing that the *whole block* is what constitutes the triangle, square, pentagon, etc. † See page 56.

‡ All figures of four sides are called *quadrilaterals*.

§ All figures that are bounded by three lines, or more, are *polygons;* but in common use the term is applied to figures that are bounded by *more than four* straight lines.

A Circle is a plane figure inclosed by a single curved line, called its *circumference*, every part of which is equally distant from a point within, called the *centre*. In popular language, however, the circumference itself is often called a circle. *Circular*.

Semicircles are half circles. *Semicircular*.

A Segment of a circle is a part of a circle cut off by a straight line. This straight line is called a *chord;* and that part of the circumference which is cut off by it is called an *arc*. An *arc* is, also, any part of the circumference.

A Quadrant is a quarter of a circle.

A Sector is the figure included between an arc and the two radii drawn to the extremities of the arc.

A Crescent is a figure in the shape of the new moon.

A Ring is any thing in the form of the circumference of a circle.

☞ For definitions of other "Forms," see Botany, page 178.

Definitions of Solids.

A Sphere is a solid body contained under a single surface, which, in every part, is equally distant from a point called its centre. *Spher'ical.*

A Hemisphere is a half sphere. *Hemispherical.*

A Spheroid is a solid body approaching to a sphere, but not perfectly spherical. It may be either *prolate*, or *oblate*. A *prolate* spheroid is one that is oblong, or prolonged, like the one represented on the Chart; an *oblate* spheroid is one that is *flattened* on two opposite sides. Thus, the earth is an oblate spheroid, because it is flattened at the poles.

A Tetrahedron is a solid bounded by four equal and equilateral triangles. See, also, page 62. For the *hexahedron*, *octahedron*, *dodecahedron*, and *icosahedron*, see page 62–3.

A Cube is a solid with six equal square sides, and containing equal angles. *Cubical.*

A Prism is a solid whose bases, or ends, are any similar, equal, and parallel plane figures, and whose sides are parallelograms. Two forms of prism are represented on the Chart. *Prismat'ical.*

A Cone is a solid body having a circle for its base, and its top terminated in a point. Cones may be of two kinds: a *right cone*, which has its axis perpendicular to the plane of its base; and an *oblique cone*, whose axis is inclined, or leaning. *Conical.*

A Cylinder is a long, circular body, of uniform diameter, its extremities forming equal parallel circles. *Cylin'drical.*

☞ The teacher should exercise the older pupils in the mensuration of surfaces and solids like those represented on the Chart, and in practical applications of the rules. They will much better remember the rules by being familiar with the *forms* of the surfaces and solids.

Compositions.—"Forms and solids" may be thought a dry subject for compositions. But every object in Nature, as well as in Art, is comprehended under certain *forms;* and every solid will be found under some one or more of the forms on this Chart and Chart No. XI., or combina-

tions of them. Let pupils, therefore, describe objects as to their shape; telling by what *lines* they are bounded, under what *surfaces* they are contained, and what *solids* they form. This will lead them to observe carefully, and to describe accurately. They will also thus learn the appropriate use of the descriptive adjective terms—the *idea* having been first obtained, and then the *word*.

CHART No. XIII. FAMILIAR COLORS.

This Chart presents a popular view of thirty-five of the principal colors familiar in painting, dress, and flowers, with the common names by which they are best known; and its object is to *train the eye* to distinguish between colors, and to recognize them when viewed separately. To aid in this object this Chart is accompanied with a duplicate set of cards, corresponding in size and color to the representations on the Chart.

For a somewhat full scientific presentation of the character, combinations, and effects of colors, we refer to the explanations of the next Chart, No. XIV. It will be sufficient here to explain to pupils, briefly, only a few of the leading principles of colors.

1. Tell them that there are only three PRIMARY colors—*red*, *yellow*, and *blue*—from which all others may be formed. Point out these three colors at the top of the Chart, and let the pupils point out, from the squares below, those that match them, and also select the corresponding colors from the cards. Let them mention, or bring in, objects whose colors correspond with these. They should be kept upon these exercises until they can distinguish readily between pure yellow, red, and blue, and their various tints and shades. (See, also, "Primary Object Lessons," p. 112, 113.)

2. Next point out the SECONDARY colors, and proceed with them in the same manner as with the primaries. After pupils have learned to distinguish these colors readily, show them by what mixtures of the primaries they are

formed. Thus, pointing to the lower right-hand corner of the Chart, show them that *orange* is formed by mixing red and yellow; *green* by mixing yellow and blue; and *purple* by mixing blue and red.*

3. Next go through with the three TERTIARIES in a similar manner. After the pupils can distinguish these readily, show them by what mixtures of the secondaries they are formed.†

4. Next take the five colors enumerated as belonging to the "Reds;" let the pupils match them from the cards, selecting *two* cards for each color, and naming the colors of the cards as each is produced. Afterward mingle the ten cards indiscriminately, and let the pupils name their colors without looking at the Chart.

5. Proceed with the "Yellows" in the same manner.

6. Proceed with the "Blues" in the same manner.

7. Proceed with the "Oranges" in the same manner.

8. Proceed with the "Greens" in the same manner.

9. Proceed with the "Purples" in the same manner.

10. Proceed with the "Browns" in the same manner.

For what constitutes leading or *standard* colors, *tints*, *shades*, and *hues*, see pages 105 and 107. What are denominated the *shades* of colors, on Chart No. XIII., are not, strictly, *shades*, although they are popularly considered such. A *shade* of a color, as described on page 10 , is

* Indigo is not, properly, a secondary color, but a *sub-secondary*, as it is one of the *shades* of purple-blue. See Chromatic Scale, Chart No. XIV. It is, however, on this Chart, No. XIII., placed among the secondaries, because it was formerly included among the distinct colors of the solar spectrum, and is still, generally, so enumerated.

† It would now be well if pupils could be supplied with the three primary colors, that they might learn to form the secondaries and tertiaries by actually mixing the primaries. The *proportions* will be best learned when they come to the next Chart; but it is best for them now to *experiment*, without rules. For some excellent observations on the early use of colors, see Herbert Spencer's work on Education, page 141–143. He recommends the use of cheap wood-cuts to be colored by the pupils. He says, "No matter how daubed and glaring the colors. The question is not whether the child is producing good drawings; the question is, whether it is developing its faculties."

formed by mixing that color with *black;* but, popularly considered, when a small portion of some *dark* color is mixed with a lighter color, so as to give to the lighter color a *darker shade,* although it may change its hue, the color thus produced is often spoken of as *a shade* of the given color. Thus, in the column of "Reds" on the Chart, a deep *crimson* (which is formed by mixing a very little blue with pure deep red) is sometimes called a crimson *shade* of red. It is, however, a misapplication of terms: the color is, properly, a dark *shade of crimson.*

After the pupil has acquired some familiarity with the Chromatic Scale, Chart No. XIV., he should return to the "Familiar Colors" of Chart No. XIII., and assign to each its proper place in the more scientific arrangement of the scale. Thus:

Reds.

- *Crimson* is one of the **Purple-Reds**. It has many tints, hues, and shades.
- *Carmine:* A pure **Red**. It has many tints and shades.*
- *Scarlet:* One of the **Orange-Reds**; of many tints, hues, and shades.
- *Vermilion:* One of the **Orange-Reds**—approaching orange.
- *Pink:* A tint of pure **Red**. Many varieties.

Yellows.

- *Citrine:* A **tertiary color**, intermediate between orange and green.
- *Yellow:* A pure **Yellow**. Chrome Yellow: of many tints and shades.
- *Lemon:* One of the **Greenish-Yellows**. Yellow slightly tinged with green.
- *Canary:* One of the **Greenish-Yellows**—so little green as to be but just perceptible.
- *Straw:* One of the tints of pure **Yellow**. Many varieties.

Blues.

- *Indigo:* One of the deep shades of **Purple-Blue**. Mazarine Blue is another of these shades, but contains more red.
- *Ultramarine:* The purest **Blue**. A primary color: many tints and shades.
- *Prussian Blue:* One of the **Greenish-Blues**. A deep blue, slightly tinged with green.
- *Light Blue:* A tint of pure **Blue**.
- *Sky-Blue:* A still lighter tint of pure **Blue**.

Oranges.

- *Amber:* A transparent **Dark Orange**, or a deep shade of **Orange-Yellow**.
- *Orange:* A **secondary** color, of many tints, hues, and shades.
- *Salmon:* A tint of **Orange-Red**.
- *Buff:* One of the **Orange-Yellows**. Many varieties.
- *Cream:* A light tint of **Orange-Yellow**.

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* The pure or primary colors have not, of course, any *hues*. See p. 107.

Greens.

Olive: A **tertiary** color, in which blue preponderates. What are called *Olive-Greens* are shades of Greenish-Blue, such as may be produced by mixtures of violet and green. Many tints, hues, and shades.

Green: A **secondary** color, of many tints, hues, and shades.*

Emerald-Green: A greenish tint of **Greenish-Blue**; that is, a light green slightly tinged with blue.

Pea-Green: A greenish tint of **Greenish-Yellow**; that is, a light green tinged with yellow.

Light Green: One of the tints of pure **Green.**

Purples.

Royal Purple: One of the rich *shades* of **Purple**—best represented by a very deep purple silk.

Purple: A **secondary** color, of many tints, hues, and shades.

Violet: One of the deeper tints of **Purple-Blue,** often approaching pure purple. Many varieties.

Lilac: A lighter tint of **Purple,** often inclining to a **Purple-Blue.** Many varieties.

Lavender: A still lighter tint of **Purple-Blue**—lighter than violet, and often inclining to a pure purple tint.

The Browns. These are not represented on the Chromatic Scale, with the exception of *russet.* For descriptions of the browns, maroons, and grays, see page 101.

Having a knowledge of the Chromatic Scale, the pupil should now be able to assign any given color to its proper place among the definite colors of the scale. Sometimes the color may be a shade, or it may be a tint of one of the definite colors. Thus, among the numerous orange-reds in cloths, worsted, etc., may be found light *scarlets,* which are tints of orange-red, at one extreme, and shades of *auburn,* which are brownish shades of orange-red, at the other extreme. A color may also be on the boundary line between two definite colors. Thus some of the orange hues approach the scarlets, and some of the scarlets approach orange; for the varieties of tints, hues, and shades are almost innumerable, and fanciful names of colors are constantly springing up, as new fabrics of new combinations of colors are presented to the public. All popular names

* The "*Dark Green*" of the Chromatic Scale should have been made darker on some of the Charts by a mixture of red, as its combination is 3 parts of yellow, 3 parts of blue, and 2 parts of red. For a similar reason, the "Dark Orange" should be darkened by blue; and the "Dark Purple" should be *browned* by yellow.

of colors should be referred to and judged by the *standards* that are represented by the definite combinations of the Chromatic Scale. From the very nature of things, there can be no other standards.

Compositions.—Let pupils write compositions upon these "Familiar Colors," describing them; naming the primaries, secondaries, and tertiaries, and telling how the secondaries and tertiaries are formed; and, more especially, describing the colors of natural objects which are presented to them, or with which they are familiar.

CHART No. XIV. CHROMATIC SCALE OF COLORS.

The following article, in connection with the Chart, is designed to give as complete a view as our limits will allow of the principles of COLORS, their combinations and proportions, tints, shades, and hues, and their varied harmonic or discordant effects upon each other when placed in juxtaposition. If we are not mistaken, it will be found that children can easily learn both the facts and the principles here presented, and that, in addition to the new and wonderful things in the beauties and in the philosophy of Nature which this subject will unfold to them, it will be found admirably adapted to the cultivation not only of the *observing*, but of the *reflective* faculties also.

It is designed that the teacher shall explain to the pupils the principles here presented, after which the pupils should make the applications by constructing the *tables*, answering the questions, and going through the exercises, and also in carrying out still farther the principles of colors. A great amount of information is contained in the present synopsis, as illustrated by the Scale, and the subject may well serve for short semi-weekly exercises during a couple of years. For written *Compositions* on colors, see the close of this article.

I. GENERAL PRINCIPLES OF LIGHT, DARKNESS, AND COLOR.

A ray of solar light, in itself white, may be separated, by passing it through a prism, into an indeterminate number of variously-colored rays, which are distributed into seven groups, termed *red*, *orange*, *yellow*, *green*, *blue*, *indigo*, and *violet* (or purple) rays. These colored rays, thus obtained, constitute what are called the *solar spectrum*. Yet all the rays comprised in the same group are not identical in color, but may be considered as differing more or less among themselves.*

When an object reflects all the solar rays to the eye, the object presents the appearance we call *white*. When it reflects none of them, it appears *black*. When what we call a *colored* object is seen, it reflects a certain portion of the solar rays to the eye, and absorbs the others. Thus, if the object reflects the *red* rays, it appears *red;* if it reflects the *yellow* rays, it appears *yellow*, etc.†

It is evident that the *absorbed* colored rays are of a different color from the *reflected* colored rays; and also that if the two kinds were reunited, they would neutralize each other, and white light would be reproduced. It is this property of two variously-colored lights, taken in certain proportions to reproduce white light, that we express by

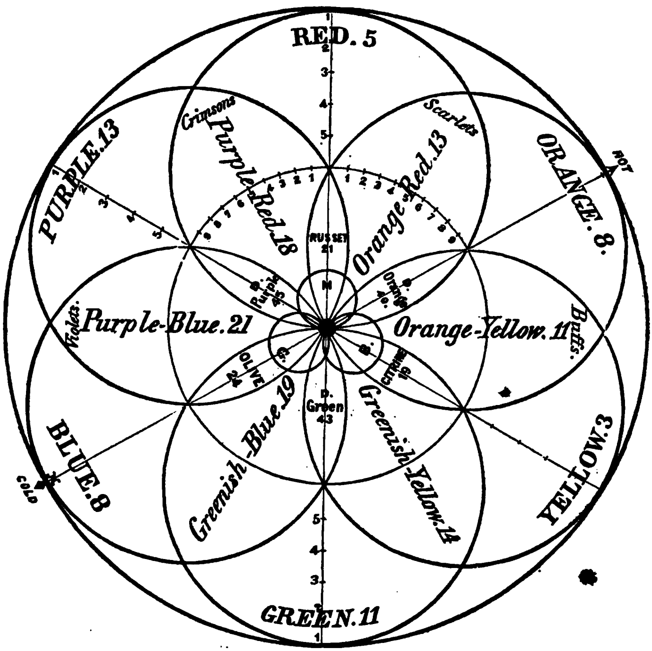
* This is the Newtonian theory of light. A theory has lately been brought forward in England, that light is simple and uncompounded—homogeneous in nature; and that as it comes to the eye, from different objects, in modified *quantities*, it impresses the sense of vision with relative forces that convey to the brain the conceptions of color. See London Review, Dec. 28, 1861. This theory, however, does not affect the principles illustrated in this article.

† But notwithstanding the general principle here stated, even the *blackest* object reflects *some* white light. Every colored object, red for instance, also reflects a *small portion* of all other colored rays besides red; yet, as the red rays are greatly predominant, we call the object red. This principle has been fully established by the experiments of Sir David Brewster. It will be important to bear this principle in mind when we come to consider the effect that colors in juxtaposition have upon each other.

the words, colored lights *complementary to each other*, or *complementary colors.*

Exercises.—Why does an object appear *red?* (Because it reflects the red rays to the eye, and absorbs the others.) Why does an object appear yellow? Why blue? Why orange? Why green? Why purple? etc.

II. THE COMBINATIONS OF COLORS, AS SHOWN BY THE CHROMATIC SCALE.



UNCOLORED MINIATURE COPY OF THE CHROMATIC SCALE.*

* The large colored Chromatic Scale shown on the Chart is mostly a combination of the scales of the English writer Field and the French writer Chevreul, embracing all the principles of both, together with what we believe to be some important improvements in modes of illustration. As additions to the Chromatic Scale of Field, it represents the normal

Although a solar ray—that is, white light—may be divided into six or *seven* differently-colored groups, yet only *three* of these groups, YELLOW, RED, and BLUE, are what are called PRIMARY COLORS. The remaining three or four are really made up of combinations of the three Primaries. It has been found that if we take the three Primaries, of equal degrees of intensity, or, in other words, the deepest and purest red, yellow, and blue, as seen in the solar spectrum, and combine them in the proportions of 3 parts of yellow, 5 parts of red, and 8 parts of blue, they produce *white* light. And yet if they are combined in such proportions that two of them considerably predominate, a grayish hue, approaching *black*, will be produced.

The union of the solar rays in such proportions as to produce white gives us the principles of the Chromatic Scale for all the regular combinations of colors. In the

or standard *tones*, fully illustrates the principles of the *tints*, *shades*, and *hues* of colors, and assigns their appropriate positions to the semi-neutral *browns*, *maroons*, and *grays*.

Some explanation is required as to the *colors* represented on the Chromatic Scale, and also on all the Charts. Some may be disappointed in not finding them as pure and brilliant as they have before seen them, and especially in *silks*. In the first place, paper made of cotton does not take color so well as silk. In the second place, as paper is bleached white by the use of *lime*, it still contains some lime, which, as painters say, "kills" the colors. The lime injures some colors more than others. In the third place, *all* colors fade more or less by exposure to the light. In the fourth place, where colors are grouped as they are on the Chromatic Scale, those that are in juxtaposition diminish the brilliancy of each other, as will be learned from the principles explained in this article. If you wish to see what any one of these colors is by itself, cover up all the others, and look at that one alone when the eye is in its normal state. All these things are difficulties which we have to contend with, and for which due allowance should be made. The colors on the Chart, however, with which very great pains have been taken, are sufficiently brilliant for all practical purposes. The *Primaries*—red, yellow, and blue—are as good as could be obtained; and so long as the others are made by the proper *mixtures*, they must present the true *comparative* hues and shades of all the other colors. The colors on Chart No. XIII. are *brighter* than on Chart No. XIV., as in the former the paper was colored in sheets, and then cut up and pasted on.

centre of this scale is a dark circle, which may either denote an object that absorbs all the solar rays, and hence appears black, or it may denote the mixture of the rays in certain proportions different from those that constitute white. Grouped around this centre are six large circles, three of which, designated as YELLOW, RED, and BLUE, represent the three **Primaries**, while their figures, 3, 5, and 8, denote the proportions in which they combine to produce white. But yellow and red combine in their respective proportions, 3 and 5, to produce ORANGE; yellow and blue in their respective proportions, 3 and 8, to produce GREEN; blue and red in their respective proportions, 8 and 5, to produce PURPLE—as shown in the circles lying between the three couplets of the Primaries. This gives us what are called the **Secondary Colors**, ORANGE, GREEN, and PURPLE, and likewise shows *their* combining proportions: that orange is made of 8 parts of colored light (3 of yellow and 5 of red); green of 11 parts (3 of yellow and 8 of blue); and purple of 13 parts (8 of blue and 5 of red).* *Indigo*, which was formerly included among the secondary colors, is merely a deep purple-blue.

If now we take the Secondary colors, and combine them two by two, we shall form the **Tertiary Colors**, RUSSET, CITRINE, and OLIVE, and have *their* combining proportions,

* Some writers say that *equal* proportions of red and yellow produce orange, *equal* proportions of yellow and blue produce green, etc. This may be true if the colors be of the *right tone* to produce such effects. Instead of taking 5 parts red and 3 parts yellow to produce orange, it is evident that we may take 5 parts of each, if we *diminish* the tone of the yellow, or *increase* that of the red. It all depends upon what *tones* of the several colors we take for the standard or normal colors; but as it is impossible to find any *pure pigments* or *paints* of these three colors, or even to be certain that we can always have them alike, it is better to take a standard that never varies,—and such we have in the colors seen in the solar spectrum. The red, yellow, and blue of the solar spectrum are therefore very properly taken as the normal or standard tones of those three colors. They are thus given in Field's Chromatography. In the very able and more recent work of the French writer, Chevreul, this matter is most strangely overlooked. We find there, indeed, no *standard* for any color.

which are found by adding the numbers of the Secondaries which form each respectively. Thus orange 8 and purple 13 form russet 21; orange 8 and green 11 form citrine 19; green 11 and purple 13 form olive 24.

Moreover, if we unite each Secondary with each of its adjoining Primaries, we shall form a fourth class, of six colors—Orange-Red, Orange-Yellow, Greenish-Yellow, Greenish-Blue, Purple-Blue, and Purple-Red—which may be called **Sub-Secondaries.** Their combining proportions, given on the Chart, follow the same rule as before given. By combining the Tertiaries, two by two, we form a fifth class, of three colors—Dark Orange, Dark Green, and Dark Purple—which may be called **Sub-Tertiaries.**

Thus far all the colors are composed of the three Primaries, and their regular combinations in *definite proportions.* Of these, the lighter or purer colors are, first, the Primaries, and next the Secondaries, which are arranged in the larger circles and around the outer portions of the Scale. Next, in point of purity, are the *Sub-Secondaries*, which are of a darker hue than either of the former classes. Then come the *Tertiaries* and *Sub-Tertiaries*, which have their appropriate grouping nearer the black centre of the Scale, and which are of a much darker and less pure hue than the Secondaries and Sub-Secondaries.

But there is a still darker class of *irregular* or broken colors, formed by no very definite mixtures of the darker colors among those already mentioned. These latter, usually called SEMI-NEUTRAL colors, embrace the three groups of the *Browns*, the *Maroons* or Chocolates, and the *Grays.*

1. The **Browns** are those very dark shades, or combinations, in which yellow, orange, or citrine predominates. There are yellow, orange, red, and purple browns, but no *blue* browns. The browns are mostly of warm or tawny hues.

2. The **Maroons** or Chocolates are those dark shades, or combinations, in which red, purple, or russet predominates. They are intermediate between the *warm* browns, and the *cold* grays. The maroons proper incline to the dark pur-

ples, and the chocolates to the dark orange, approaching the browns.

3. The **Grays** are those dark shades, or combinations, in which blue, green, or olive predominates.

Hot and Cold Colors.

As *blue* possesses, in the greatest degree, the quality technically called *coldness* in coloring, and as it communicates this property variously to all colors with which it is compounded, the Chromatic Scale shows blue as the coldest color, whence the coldness gradually diminishes until the *medium* between the cold and the hot colors is attained at purple-yellow and yellowish-green. From these two points the warm colors increase gradually until they attain their maximum of heat at *orange*, the complementary of the cold *blue*.

Let the pupil now tell, from the Chromatic Scale, the relations, as to heat and cold, which the colors sustain to each other.

Retiring and Advancing Colors.

Purple is the most *retiring* color, as shown on the Chromatic Scale (see Chart); that is, it declines in power the most rapidly in proportion to the distance at which it is viewed, and also in a declining light.

Its complementary *yellow*, on the contrary, is the most *advancing* of all colors, partaking most of the nature of white, and consequently of greatest power in reflecting light.

As to the beauty of colors individually; that is, when viewed alone, it may be stated, that those colors which are nearest in nature to light, have their greatest beauty in their lighter tints; and that those which are nearest in nature to shade, are most beautiful in their greatest depth or fullness—a law which of course applies to *black* and *white* particularly. Thus, the most beautiful *yellow*, the color most like white, is that which is lightest and most vivid; *blue*, the color most like black, is most beautiful when deep

and rich; and *red*, when of intermediate depth, or somewhat inclined to light.

III. TABLE OF COLORS; THEIR COMBINATIONS, PROPORTIONS, AND COMPLEMENTARIES.

See the Chromatic Scale.

	Colors.	*Their Combinations and Proportions.*	*Their Complementaries.*
Primaries.	Yellow 3		Purple 13.
	Red 5		Green 11.
	Blue 8		Orange 8.
Secondaries.	Orange 8	= (Red 5, Yellow 3)	Blue 8.
	Green 11	= (Yellow 3, Blue 8)	Red 5.
	Purple 13	= (Red 5, Blue 8)	Yellow 3.
Tertiaries.	Citrine 19	= (Or. and Gr. = Red 5, Yel. 6, Blue 8)	Purple 13, or Dark Purple 45.
	Olive 24	= (Gr. and Purp. = Yel. 3, Red 5, Blue 16)	Or. 8, or Dark Or. 40.
	Russet 21	= (Or. and Purp. = Red 10, Yel. 3, Blue 8)	Gr. 11, or Dark Gr. 43.
Sub-Secondaries.	Orange-Red 13	= (Or. 8, Red 5 = Red 10, Yel. 3)	Greenish-Blue 19.
	Orange-Yel. 11	= (Or. 8, Yel. 3 = Red 5, Yel. 6)	Purple-Blue 21.
	Greenish-Yel. 14	= (Gr. 11, Yel. 3 = Yel. 6, Blue 8)	Purple-Red 18.
	Greenish-Bl. 19	= (Gr. 11, Blue 8 = Yel. 3, Blue 16)	Orange-Red 13.
	Purple-Bl. 21	= (Purp. 13, Blue 8 = Blue 16, Red 5)	Orange-Yellow 11.
	Purple-Red 18	= (Purp. 13, Red 5 = Blue 8, Red 10)	Greenish-Yellow 14.
Sub-Tertiaries.	Dark Or. 40	= (Rus. 21, Cit. 19 = Red 15, Yel. 9, Bl. 16)	Olive 24.
	Dark Gr. 43	= (Cit. 19, Ol. 24 = Red 10, Yel. 9, Bl. 24)	Russet 21.
	Dark Purp. 45	= (Rus. 21, Ol. 24 = Red 15, Yel. 6, Bl. 24)	Citrine.

I. Exercises from the Scale, on the Primaries, Secondaries, and Tertiaries.*

1. Name the three Primary colors, and their respective combining numbers.

2. The combinations of the Primaries, two by two, form the three Secondary colors, lying between the three couplets that may be formed of the Primaries.

How is orange formed? By the combination of yellow and red. In what proportions? Three parts of yellow, and 5 of red. What, then, is the combining number of orange? Eight. Why? Because 3 parts of yellow and 5 parts of red make the *eight* parts which constitute orange.

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* All the exercises under this head, and, indeed, all pertaining to Chart No. XIV., should be gone through with by the pupils, by the aid of the *Chromatic Scale* alone. What we have written out under the head of "Exercises" on the Chromatic Scale, is designed merely as a guide and aid to the teacher. He should make himself thoroughly master of the principles, and then *lead* the pupil to master the same from the Scale, as from a map. As soon as the pupil has learned the positions of the colors on the Scale, so that he can recall them without the aid of the Chart to look at, he will be able to name the several colors, and describe their combinations, with the same facility that he is able to bound countries by remembering their relative positions on a map.

3. Go through with the composition of green, in a similar manner.

4. Go through with purple in the same manner.

5. The combinations of the Secondaries, two by two, form the three *Tertiary* colors, citrine, russet, and olive, which are found, on the Scale, at the intersections of the three couplets of the Secondaries.

How is russet formed? By the combination of orange and purple. In what proportions? Eight parts of orange, and 13 of purple. What, then, is the combining number of russet? *Twenty-one.* Why? Because 8 parts of orange and 13 of purple make the 21 parts which constitute russet.

How many Primary colors enter into the composition of russet? The whole three, red, yellow, and blue. In what proportions? Red 10, yellow 3, and blue 8. Explain the reason of this. Russet is formed by the combination of the two Secondaries, orange and purple; but orange is composed of 5 parts of red and 3 of yellow; and purple of 5 parts of red and 8 of blue; therefore, red is taken twice, and yellow and blue each once; and thus we have 10 of red, 3 of yellow, and 8 of blue.

6. Next go through with citrine and olive in the same way.

7. A class of six colors, called *Sub-Secondaries*, and lying between the Secondaries and Primaries on the Scale, is formed by combining each Secondary with each of its allied Primaries, in the proportions designated by their respective numbers. Thus, red and yellow are united to produce orange, after which the orange itself may be combined with red to form orange-red.* This latter color thus has 10 parts of red and 3 parts of yellow—a proportion of *red* just *twice* what is contained in orange. In a similar manner orange-yellow is formed, containing just twice the *yellow* contained in orange.

II. Exercises from the Scale, on the Sub-Secondaries and Sub-Tertiaries.

Explain, from the Scale, the formation of orange-red, and show why 13 is its combining number. Orange-red is formed by combining 8 parts of orange with 5 parts of red. But *orange itself* is formed of 3 parts of yellow and 5 parts of red. Therefore, substituting, in the place of the orange, the yellow and red Primaries which compose it, we find that all the colors and proportions which make up the orange-red are 10 parts of red and 3 parts of yellow, making 13 parts in all.

Explain the formation of orange-yellow, in a similar manner. Of greenish-yellow. Of greenish-blue. Of purple-blue. Of purple-red.

When we combine the Tertiaries, two by two, we form the class of *Sub-Tertiaries*, consisting of dark orange, dark green, and dark purple. It will now be easy to tell how each of these is formed, and in what proportions each of the Primaries enters into the combination. For example: dark orange is composed of its two adjoining Tertiaries, russet and citrine—21 parts of russet, and 19 of citrine. But, as has been before shown,

Russet =red 10, yellow 3, blue 8, and
Citrine =red 5, yellow 6, blue 8.

Therefore, adding together the two,

Dark orange=red 15, yellow 9, blue 16; the whole making 40.

* These orange-reds are familiarly termed *Scarlets*, as the orange-yellows are termed *Buffs*.

The pupil, being familiar with this step, should next explain, in a similar manner, the formation of dark green and dark purple.

It will be seen, from the Scale, that each *Primary* color enters into all the colors embraced within its own circle and the circles on each side of it; and that, also, crossing the centre of the Scale, it enters into the Tertiary or Sub-Tertiary directly opposite. Thus, yellow enters into all the colors of the Scale *except* blue, purple-blue, purple, purple-red, and red, and *some* of the grays and some of the maroons. Crossing the centre of the Scale, it enters into dark purple.

Into what colors does *red* enter?

Into what colors does *blue* enter?

IV. TONES: EMBRACING TINTS AND SHADES OF COLORS.

Whatever we take as the *standard* of intensity or purity for any color, it is evident that the particular color assumed as the standard may receive numerous modifications by mixing with white (or diluting with water) until the lighter *tints* thus formed shall fade away and be lost in whiteness itself. Thus, suppose *carmine*, of a certain degree of depth or intensity, to be the standard color for pure red, and that 6 grains of this carmine cover a square inch of surface, so as to give to this surface the true standard color. Next take 5 grains of carmine, and mix with 1 grain of pure white, to cover the same extent of surface, and this will give a *tint* of pure red. Next mix 4 grains of carmine and 2 of white, to cover the same extent of surface, and we shall have another *tint* of red. Three grains of carmine and 3 of white will give still another tint; 2 of carmine and 4 of white a still fainter tint; 1 of carmine and 5 of white a tint of red which is barely perceptible. We have supposed the standard of pure red to be placed, on the Chromatic Scale, at the centre of the red circle, and on the radius extending outward have marked off the gradually diminishing tints—the figures 5, 4, 3, 2, 1, denoting the gradually diminishing proportions of pure red. For greater distinctness, however, we have represented only the standard red, and two of its tints, on the Chart.

In the same manner we may suppose that the yellow, the blue, the orange, the green, etc., have their normal or ruling tones, or standards, at the centres of their respective circles, and that from these points each is gradually tinted

off to the circumference, where its colors fade away in tints scarcely perceptible.

But, as opposed to this *tinting*, each of the standard colors of red, orange-red, orange, yellow, green, etc., may be, in a similar manner, mixed with *black*—in gradually diminishing proportions of color, and gradually increasing proportions of black—until the color is lost in blackness itself. Thus, at the centre of the red, on the Chromatic Scale, suppose, as before, that the normal red is placed. Mark off five divisions on the radius extending toward the centre of the Chromatic Scale. Suppose that the first division is covered by a mixture of 5 parts of red and 1 part of black; the second by 4 parts of red and 2 parts of black; the third by 3 parts of red and 3 parts of black; the fourth by 2 parts of red and 4 parts of black; and the fifth by 1 part of red and 5 parts of black. We thus obtain what are called the different *shades* of pure red; and, in a similar manner, the *shades* of all the colors are found. The *tints* and the *shades* of a color are called, collectively, its *tones*. The tones of any *one* color (embracing its tints and shades) may thus be supposed to be found on some one single radius of the Chromatic Scale—the tints of the colors represented around the outer portions of the Scale being found *outside* of the circle (A) that passes through the centres of the six large circles, and the shades being found *inside* of that circle.

But each of the Tertiaries and Sub-Tertiaries—although their *standard* colors are much darker than the standards of the Primaries and Secondaries—has both *its* tints and shades also, and the dividing line between them may be supposed to be the centres of the oval figures containing their names. So, likewise, of the still darker colors, the maroons, the browns, and the grays. If, then, each of the twenty-one normal or ruling colors represented on the Chromatic Scale has five tints and five shades that may be easily distinguished by the eye, we shall have not only twenty-one normal colors, but 210 distinguishable *tints* and *shades* of these colors, without enumerating their numerous

hues. But we have no names for all these tints and shades, nor is it necessary, nor desirable, that we should have. We may call carmine the standard *red*, and locate it on the dividing line between its tints and its shades; and we may call the tints *light* reds, and the shades *dark* reds. Occasionally we give a name to some uncertain tint or shade of a color; as, for example, we speak of *rose color*, which is merely one of the uncertain *tints* of pure red or carmine; of *straw color*, which is a light tint of pure yellow; of *mazarine-blue*, which is a shade of purple-blue; and of *amber*, which is so dark a *shade* of orange-yellow, or dark orange, that it is often classed with the browns.

V. HUES OF COLORS.

All mixed colors (which include all the colors except the Primaries) may vary greatly in their mixtures, so as to present a great variety of *hues* of each. Thus, for example, suppose, at the central part of the orange-red, where we have placed the hyphen of the word, is found the standard for this color, or, as it is usually called, *scarlet.* Now, as we pass to the left along the figures to 1, we may suppose that the yellow diminishes and the red increases; but as we pass to the right, to 9 or 10, the red diminishes and the yellow increases. In other words, the yellow may gradually increase in proportion from 1 to 10, at which latter point the yellow is sufficient, mixed with the normal red, to produce the normal or standard orange. Thus we may have many *hues* of orange-red or scarlet; and, in like manner, many *hues* of all the mixed colors.

Yet the scarlets themselves (or orange-reds), as will be seen by looking at the Chromatic Scale, may be considered as merely different *hues* of orange; that is, those orange colors in which the red preponderates over the yellow; and in a similar manner the buffs (or orange-yellows) may be considered as those hues of orange in which the yellow preponderates over the red.

Great Number of Distinguishable Colors.

Thus we may have *twenty hues* of orange, easily distinguishable, the one from the other, by an ordinary eye—these hues approaching, through the orange-reds, to pure red at one extreme, and, through the orange-yellows, to pure yellow at the other. In the same manner we may assign twenty hues to green, and twenty hues to purple. These will give to the three Secondary colors (including the Sub-Secondaries) *sixty hues* in all—all easily distinguishable.

But every one of these *hues* may have both *tints* and *shades*, as it approaches the centre, or the circumference, of the Chromatic Scale. If we concede five tints and five shades to each hue, these sixty hues will give us *six hundred* easily discernible colors! The three Tertiaries will give us an additional list of six hundred colors, and the Sub-Tertiaries another six hundred. Giving to red, blue, and yellow, five tints and five shades each, we shall thus make up a list of *one thousand eight hundred and thirty* easily distinguishable colors, without including the semi-neutral maroons, browns, and grays, which are, really, by far the most abundant colors in nature. It would not be at all extravagant to assign to the latter three the same number of colors as to the three Secondaries—six hundred in all. Our list would thus foot up the number of *two thousand four hundred and thirty colors*, all of which, we have no doubt, might be easily distinguished as separate and distinct from each other.

To show that these estimates are not extravagant, we will state, that we visited a wholesale worsted store in New York city, and that we there found a list of more than *two thousand* worsted colors alone; and we were assured that they had all the worsteds to match them. We examined great numbers of the very large lists of the hues, tints, and shades of orange worsted, and found no difficulty in distinguishing between them. When the orange hues, tints, and shades are so numerous, it is not surprising that

people differ so much in their views of what constitutes a standard orange, a standard scarlet, or a standard buff.

VI. COMPLEMENTARY COLORS.

Under the head of "General Principles of Light, Darkness, and Color," we briefly explained that when two colors can be taken in such proportions as to produce white, each color is called the *Complementary* of the other. Now red, yellow, and blue, taken in the proportions of 3 parts of yellow, 5 parts of red, and 8 parts of blue, and of the purity of these colors in the solar spectrum, neutralize each other; that is, produce white.* Hence, if we first combine the yellow and the blue, *their* product, which is *green*, must be the complementary of red, and red must also be the complementary of green.

Exercises on the Chromatic Scale.

What is the complementary of red? Of yellow? Of blue? Explain the reason in each case.

(NOTE.—The complementary of any color on the Scale is the one *directly opposite* to it, on the same diameter, and can easily be learned, and recalled at any time by remembering the arrangement of the Scale. The *Table* before given also names the complementaries. Aided by the Chromatic Scale only, each pupil should not only explain the complementaries, as in the following exercises, but also write out a Table of the colors, like that given on page 103.)

What is the complementary of orange-red? Greenish-blue.

What is the complementary of greenish-blue? Orange-red. Why?

Explanation.—Orange-red =red 10+yellow 3; and
Greenish-blue= yellow 3, blue 16; and the two
=red 10+yellow 6+blue 16. But these last proportions are equivalent to red 5, yellow 3, and blue 8, which are the proportions in which the three Primaries neutralize each other; that is, combine to produce white. Thus it is shown that if orange-red and

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* It must be borne in mind, however, that, in point of fact, we cannot produce a *white* paint by mixing those pigments or paints whose colors are complementary. Thus, although the groups red and green, orange and blue, yellow and purple, should, according to the theory, produce white when respectively mixed in their proper proportions, yet we know that they produce a *gray*, approaching nearer to white as the colors are purer. The principles of the combinations and effects of colors must, however, be based upon some *standard*, and none better can be taken than the *pure* colors of the solar spectrum.

greenish-blue be combined they produce white, and therefore the one is the complementary of the other.

In a similar manner, look at the Chromatic Scale, and name the complementary of orange-yellow, and explain the principle.

Of greenish-yellow. Of greenish-blue. Of purple-blue. Of purple-red.

In a similar manner, name the complementary of russet, and explain the principle.

Explanation.—In order to explain that *dark green* is the complementary of russet, we first show that dark green is composed of

red 10, yellow 9, blue 24;

Russet is composed of red 10, yellow 3, blue 8;

The two equaling red 20, yellow 12, blue 32. But these are in the same proportions as red 5, yellow 3, blue 8, which are the neutralizing proportions of the three Primaries.

In a similar manner name the complementary of dark orange and explain the principle.

Of citrine. Of dark green. Of olive. Of dark purple. Let it be observed that, as the combining figures of the three Primaries make up the number 16, so any two complementary colors, which represent the equivalent combinations, must add up the same number 16, or multiples of 16. Thus, each couplet of primary and secondary complementaries forms the number 16; each couplet of the sub-secondary complementaries forms the number 32; and each couplet of tertiary and sub-tertiary complementaries forms the number 64.

VII. THE HARMONY OF COLORS.

As *light*, which is the natural stimulus of the healthy eye, and more agreeable to it than any single color, is composed of the three Primary colors in certain proportions—that is, in such proportions as to neutralize each other—light may be considered a *perfect harmony*, or union of all colors.

From the principle herein developed it is apparent (and experience proves it) that if a single color, red, for example, be alone presented to the eye, an uneasy feeling is soon produced in that organ. What is then needed to soothe the eye is the presentation of such other color or colors as shall neutralize the red—that is, which, if combined with it, would produce white. Yellow and blue, in their respective proportions, will produce this effect, or, what amounts to the same thing, their equivalent *green*. Hence, if *two* colors can be used to harmonize with red, the two must be yellow and blue; or, if *one* only can be taken, it must be green.

We thus obtain this first general rule in the harmony of colors. *The single color that harmonizes best with any given color, is the complementary of the given color.* It will now be easy to answer the following questions, and assign the reasons.

What single color harmonizes best with standard yellow? (Standard purple.) Why? Because 13 parts of standard purple added to 3 parts of yellow produce white. Show why 13 parts of purple and 3 of yellow produce white. (See Div. VI.)

What single color harmonizes best with blue? (Orange.) Why? With orange-red? With orange-yellow? With greenish-yellow? With greenish blue? With purple-blue? With purple-red.

What with russet, citrine, and olive?

Observe that each of these Tertiary colors has two complementaries, as shown in the Table, page 108. Explain why either green, or dark green, is the complementary of russet. The same of the other two Tertiaries.

Harmonic Effects of placing Side by Side Colors that are Complementary.

If two complementary colors, blue and orange, for example, be placed side by side, it is found that each appears brighter, or more intense, than when viewed separately.* Thus the complementary colors are found not only to harmonize best with each other in their combined pleasurable effects upon the organ of sight, but also to *contrast* more strongly with each other than with any other colors. The following has been adduced as the *cause* of this effect.

Every colored object, when viewed alone, reflects not only the particular rays which, by being the most numerous, designate the color of the object, but also a portion of *all kinds* of colored rays. Thus blue, viewed by itself, reflects some orange rays, by which its blue may be supposed to be modified or lessened, so far as the orange rays neutralize their proper proportion of blue rays. The orange also, when viewed by itself, reflects some blue rays, by

* The supposition is that the two colors are either of the normal standard, or of the *same* tone: that is, of corresponding depth of tint or shade. If the colors be not of the same tone, the lighter tone will appear still lighter, and the darker tone will appear still darker—that is, of a deeper shade.

which the orange is, in a similar manner, modified or diminished in intensity.

Now suppose the blue and the orange placed side by side. What will become of the orange rays which the *blue* reflects? They will be overwhelmed—virtually extinguished—by the more intense rays which the *orange itself* reflects, just as the light of a candle is overwhelmed by the full glare of the noon-day sun. The blue, thus deprived of the force of its orange rays, will appear of a more intense blue than before. Upon the same principle, the orange, by its juxtaposition with blue, will appear of a more intense orange than before. The same principle will apply to all the colors when arranged as complementaries. They then produce their greatest effect, and present the most striking contrasts.* The striking effects of these harmonies are best shown by taking circles of the three primary colors, red, blue, and yellow, and surrounding them with broad rings of their complementaries, as is seen under the head of "Harmonic Complementary Colors" on the Chart. Here, on circular, green, orange, and purple grounds, are pasted smaller circles of their respective complementaries, red, blue, and yellow. Each color, according to the principles stated, should be rendered the more brilliant and intense by this juxtaposition; and this effect we believe will be apparent to the eye of almost any person. But, to render the effect more apparent, the *same* green, orange, and purple grounds are placed to the right of the others, and on them are pasted precisely the same red, blue, and yellow colors as before, for they are cut from the *same sheets* of colored paper; but they are here so arranged that the contiguous colors shall not be complementaries. The six complementary colors on

* It is owing to this same principle that the *dapplings* of two complementary colors produce effects in painting so much more clear and brilliant than when uniform tints are produced by mixing the two colors. White and black are, practically, complementaries. If they be mixed, they produce a *gray*—of little or no brilliancy, as is seen in an ordinary lithographic print; but if the black be *dappled* in, as in the finest steel engravings, the contrasts are the most striking, and the effect the most brilliant.

the left are now plainly seen to be more brilliant than the same six colors on the right.

The teacher must constantly bear in mind that it is impossible, as before stated, to give to ordinary paper the same brilliancy of coloring that may be given to some other materials, and especially to silks. If the complementary colors on the left were richly-colored silks, the brilliancy of effect would be absolutely painful to the eye.

Another explanation of the effect produced by placing side by side complementary colors, is the well-known *fact* that the eye, by looking intently at any color for a few moments, acquires a tendency to see its complementary. Thus, place a bright red wafer on white paper, and look at the wafer intently for a few moments, and the space around the wafer will assume a *greenish* tinge; or cast the eye from the wafer upon a white surface at some distance from it, and the figure of a light *green* wafer will be seen there. In the same manner, if the eye look intently for some time upon a green wafer on white paper, the surrounding space will assume a *reddish* tinge. Hence, when red and green are placed side by side, each must give to the other an additional depth and brightness of color.*

Exercises.—If a silk merchant wished to make a *red silk* appear to the best advantage, what color would he place beside it? (A green silk.) Why? If an *orange* silk, what color should he place beside it? If a bright *yellow* silk? A *green* silk? A *blue* silk? A *purple* silk? A *purple-red* silk? An *orange-red?* An *orange-yellow?* A *greenish-yellow?* A *russet* silk? (Either green or dark green.) A *citrine?* An *olive?*

* But *why* does the eye, after looking intently for some time at any one color, acquire a tendency to see its opposite or complementary color? The following physiological explanation may be given of this remarkable phenomenon. The eye is supposed to *secrete* the principles of light, and to retain them in a latent state; and when any single color is presented to the eye, it is supposed so to act on that organ as to call forth the latent principle which is needed to restore the equilibrium of white light. Thus *red* light is supposed so to act upon the organ as to call forth the latent principle of *green* light, the latter being what is needed to harmonize the red. It seems to be one of those wonderful compensating provisions of nature which is designed to prevent injury to the organ.

But although the complementary colors, when placed side by side in broad stripes, impart additional brilliancy to each other, yet if they are so intimately mingled (and in their due proportions) that the eye can not well distinguish each separately, they will to a considerable extent *neutralize* each other, and, tending to white, give to the mixture a *grayish* hue. Thus, if threads of red and green be interwoven in a carpet, in the proportions of 5 of red and 11 of green—or, what is nearly the same, 1 of red and 2 of green —a *gray* will be produced. If the coloring material used were as *pure* as in the solar spectrum, the color produced would be nearly white. But if the red and the green be in *broad stripes* in the carpet, each will appear more brilliant than when viewed apart.

We have said that if any *one* color be given, the *single* color that best harmonizes with it is its complementary. Yet the complementaries contrast *so strongly*, and are so vividly bright, especially those of the Primaries, that the eye soon wearies of them; and if they are to be constantly before the eye, a more agreeable effect is produced by the interposition of a third color which partakes of both extremes of the contrast, or which is placed intermediate between them on the Chromatic Scale. Thus blue and orange, when placed so as to contrast with each other, become reconciled, softened in effect, and better harmonized to the eye, when a broken color, partaking of both, or one intermediate between the two, is interposed. Thus equal surfaces of blue and orange would be better harmonized to the eye by the interposition of a surface of greenish-yellow or purple-red about equal to both the others. Yellow or purple interposed would produce a *similar* effect, but not so good as the others. The figures attached to the colors on the Scale give their respective *harmonizing* as well as *combining* proportions. Thus orange, blue, and purple-red harmonize best in the proportions of 8 of orange, 8 of blue, and 18 of purple-red;* and if these three colors were to be

* In all such statements reference is had to the *normal* or *standard tones* of the colors; and if either of the colors used be below the standard—that

combined in a dress, their harmony would best be consulted by having some regard to these proportions.

Exercises.—Take all the colors in their complementary grouping, and, by referring to the scale, tell what third colors best soften and harmonize them to the eye. The *third* color will be *either* of the two intermediate between them on the scale. The following table gives the grouping of the complementaries, and the third colors which best soften and harmonize them, yet this table is not half so good as the scale itself. When the arrangement of the colors on the Chromatic Scale is once learned, the mind can easily recall all these harmonies.

Red Green	best harmonized by	Orange-Yellow, or Purple-Blue.
Orange-Red Greenish-Blue	" " "	Citrine or Yellow, or Purple, or Dark Purple.
Orange Blue	" " "	Greenish-Yellow, or Purple-Red.
Orange-Yellow Purple-Blue	" " "	Red, or Russet, or Green, or Dark Green.
Yellow Purple	" " "	Orange-Red, or Greenish-Blue.
Greenish-Yellow Purple-Red	" " "	Orange or Dark Orange, or Blue or Olive.
Citrine Purple	" " "	Orange-Red, or Greenish-Blue.
Olive Orange	" " "	Purple-Red, or Greenish-Yellow.
Russet Green	" " "	Orange-Yellow, or Purple-Blue.
Etc.		

Yet it is evident that any two complementary colors are not perfectly harmonized by any *one* additional color, but that a complete harmony requires *two* additional colors. Thus, if we take red and green, although they are complete harmonies, yet their brilliant and harsh contrast requires modification. Orange-yellow softens their severity, but requires its own complementary purple-blue to restore the harmony which has thus been broken; that is, for all the colors to present the proportions required in the production of white light. Therefore the complementaries group-

is some *tint* of it—additional extent of surface should be used to compensate for the deficiency. Thus, if the third tint of orange should be used (see Chromatic Scale and Div. IV.), containing only *half* the orange found in the standard, a *double* surface of orange should be contained in the dress.

ed in the left-hand column of the foregoing table require the *two* colors in the right-hand column to soften and fully harmonize them. For the same reason, if the complementary groups in the right-hand column were to be softened, and then harmonized, both the colors in the left-hand column would be required for that purpose.

Taking the principles here developed as a basis, the teacher may now form a great variety of questions as to the proper selection and proportions of colors in dress, in the paintings of the interiors of rooms, in paper-hangings, and in carpets and tapestry.

VIII. DISCORDANT EFFECTS OF THE JUXTAPOSITION OF NON-COMPLEMENTARY COLORS.

Two colors of equal or nearly equal intensity (each one being of its normal tone, or both of corresponding tones) placed side by side, are said to be *discordant* when each produces such an effect upon the other as to cause the two to differ more than they would when viewed separately—that is, to separate them farther from each other in composition than in the order in which they are arranged on the Chromatic Scale. Thus it is found that if orange and green, both of which contain yellow, are placed side by side, the *orange* will thereby assume more of a *reddish* tinge, and the *green* more of a *blue* tinge—the former appearing to the eye as an orange-*red*, and the latter as a greenish-*blue*. By this juxtaposition of orange and green each of the colors will seem to lose a portion of its yellow, and thus to be separated farther in their composition than they really are, thus inclining *farther apart* on the Chromatic Scale.

It will now be easy, by keeping in mind the arrangement of the colors on the Scale, to tell the effects of the juxtaposition of any two of them, of the standard purity; for each will thereby partially assume the hue of the color next to it on the Scale, on the *outside* of the two colors—not between them. In the following groupings, the effects denoted in the right-hand column will be produced. The teacher should point out the groupings on the Scale, and

let the pupil name the results. Thus, for example, the teacher points out red and orange, and asks what will be the result if these two colors are placed side by side in a dress, or in a carpet, etc., without any other colors to relieve or harmonize them. According to the rule, the pupil will see that the red will incline to purple, and the orange to yellow—the red becoming a purplish-red, and the orange a yellow-orange.

No. 1.	Red	inclines to	Purple.
	Orange	" "	Dark Yellow, or Citrine.
2.	Red	" "	Purple.
	Yellow	" "	Green.
3.	Red	" "	Orange.
	Blue	" "	Green.
4.	Red	" "	Orange.
	Purple	" "	Blue.
5.	Orange	" "	Red.
	Yellow	" "	Bright Green.
6.	Orange	" "	Bright Red.
	Green	" "	Blue.
7.	Orange	" "	Yellow.
	Purple	" "	Blue.
8.	Yellow	" "	Bright Orange.
	Green	" "	Blue.
9.	Yellow	" "	Orange.
	Blue	" "	Purple.
10.	Green	" "	Yellow.
	Blue	" "	Purple.
11.	Green	" "	Yellow.
	Purple	" "	Red.
12.	Blue	" "	Green.
	Purple	" "	Red.

The *cause* of the foregoing effects may be explained upon the principle before stated, that when any two colors of similar tone are viewed in juxtaposition, each produces the effect of adding its complementary to the other.*

* It must continually be borne in mind, that in all these cases the two colors are of the same, or nearly the same, tone; that is, either of the standard intensity, or equally removed from it in tint or shade. But if one of the colors be of a deep *shade*, and the other of a light *tint*, the former will appear still deeper, and the latter still lighter, by the effect of the contrast. Therefore, a very deep blue, when placed beside a very light yellow, may make the latter appear so much lighter as to destroy the complementary effects, and, as it makes the yellow pale, to give it

Suppose that, in a certain painting, it is wished to have orange largely predominate, and yet to represent, in their purity, and of the normal standard, the colors red, purple, scarlet, yellow, and green. Now, first, what will be the effects, in the painting, of putting all the colors in of exactly their normal standard? Ans. The red will appear too purple, the purple too blue, the scarlet too red, the yellow too green, and the green too blue. How, then, must the colors be changed in hue, to make the representation accurate? Ans. The reds must be more scarlet, the purple more red, the scarlet more orange, the yellow more orange, and the green more yellow.

Make similar suppositions as to other colors; and, on the supposition that red, yellow, green, blue, or purple is to preponderate in large proportion, require the pupils to tell the effects.

It will now be easy to see what *third* color is needed to harmonize any one of the foregoing groups given in the table; for it is evident it must be that color which, when combined with the two given colors, will be *their* complementary; that is, such color as, when allied to the two, will give the requisite proportions for white light. Let us take, for example, the first group, red and orange. What *third* color will best harmonize them? It must be the one *opposite* to them on the Chromatic Scale; that is, greenish-blue. If this be correct, red, orange, and greenish-blue, when combined, must give the proportions of white light. We will try the combination:

		Red.	Yellow.	Blue.
Red	=	5	0	0
Orange	=	5	3	0
Greenish-Blue	=	0	3	16
The whole equal.........		10	6	16,

which is equivalent to red 5, yellow 3, blue 8—the proportions in which the three Primaries combine to produce white. Therefore the color which best harmonizes any two discordant colors

almost a greenish tinge; for, the paler a yellow is, the greener it appears. See the next division—"Contrast of Tone."

is their complementary, which is found on the *opposite* side of the Chromatic Scale, intermediately between them.

Let the teacher now take the same groupings as before, and require the pupil to tell, from the Chromatic Scale, what third color is required to harmonize each group.

Red and Orange	harmonized by	Greenish-Blue.
Red and Yellow	" "	Blue.
Red and Blue	" "	Yellow.
Red and Purple	" "	Greenish-Yellow.
Orange and Yellow	" "	Purple-Blue.
Orange and Green	" "	Purple.
Orange and Purple	" "	Green.
Yellow and Green	" "	Purple-Red.
Yellow and Blue	" "	Red.
Green and Blue	" "	Orange-Red.
Green and Purple	" "	Orange.
Blue and Purple	" "	Orange-Yellow.

The Tertiary colors are harmonized on the same principles. Although their harmonies *with each other* are the least striking of all the harmonies, and require a cultivated taste to be appreciated, yet these are the harmonies which most prevail in nature, as is seen in the boundless variety of subdued colors in the foliage and trunks of trees, in grasses, in mosses and lichens, in rocks, in earths, in the plumage of birds, and the coverings of animals.

But the Tertiaries not only harmonize with each other on the principles before explained, but also each pair harmonizes, and in a more striking manner, as may be seen by the Chromatic Scale, with its complementary primary. Thus russet and citrine, having orange for a common constituent, are harmonized by blue; russet and olive, having purple for a common constituent, are harmonized by yellow; and olive and citrine are harmonized by red. The teacher should require his pupils to point out these various harmonies.

Contrast of Tone.—We have noticed the *intensifying* effects of placing side by side complementary colors of corresponding tone, and also the *change in hue* produced by the juxtaposition of allied or analogous colors that are not complementary. But a third and still different effect is

produced by the juxtaposition of different *tones* of the *same* color, and also by the juxtaposition of different tones of different colors.

Thus, if we look simultaneously upon two stripes of different tones of the same color, placed side by side, such as a deep red and a very light or pale red, the pale red will be made to appear still paler by the effect of the contrast, and the deep red will appear of a still deeper or darker hue. The effects will be the most apparent where the two stripes border on each other.

But even if the two colors are not different tones of the same scale, even if they are different tones of *different* colors, like a very deep red and a very pale yellow, the same effects will be produced, for that which is deep will appear still deeper, and that which is light will appear still lighter by the effect of the juxtaposition. This is what is called *contrast of tone*, and is an important principle affecting the arrangement of colors in dress.

The *causes* of this contrast of tone are similar to those explained under the head of the "Harmonic effects of Complementary Colors."

IX. ARRANGEMENT OF COLORS WITH WHITE.

All colors that are not too deep gain in brilliancy and effect by their juxtaposition with white; and, as a general rule, white placed beside a color *heightens* its tone, or gives it greater intensity—that is, more color. Although the cause of this effect embraces the same *principle* as before explained when treating of complementary colors, it may be well to present it anew here.

Suppose *red* and *white* placed in juxtaposition. The white rays which the red reflects, and which diminish the brilliancy of the red when the red is viewed alone, are overwhelmed—virtually destroyed in effect—by the more intense white rays when the white is placed beside the red. The effect of the juxtaposition must therefore be to render the red more brilliant, by thus destroying the effect of the white rays which before diminished its brilliancy. More-

over, as the adjoining white is rendered slightly greenish by the complementary of the red, this gives additional brilliancy to the red.

As the *depth of tone* of a color has a great influence upon the effect of its association with white, the following may be considered the best assortments with white, in the order of their greatest beauty: 1st, light blue and white; 2d, rose and white; 3d, deep yellow and white; 4th, bright green and white; 5th, violet and white; 6th, orange and white. Dark blue, dark red, very dark green, and dark purple, are far less agreeable with white than the lighter tones of these colors; for the contrast may be so great that they will appear almost black. As yellow, on the contrary, is the color nearest approaching to light, it must be of its normal or deepest tone to produce its best effect when associated with white.

Let the pupil now tell the double effect, both on the white and on the color, of the following groupings.

1. Red and white. 2. Orange and white. 3. Yellow and white. 4. Green and white. 5. Blue and white. 6. Purple and white. 7. Black and white.

Explanation, thus: When red and white are associated, a slight greenish tinge is given to the white by the addition to it of the complementary of the red,* while the red is rendered more brilliant and deeper, both by losing the effects of its own white rays, and by having its complementary added to the white.

Explain also why black is rendered more intensely black by being associated with white.

X. ARRANGEMENT OF COLORS WITH BLACK.

A black surface, by being placed in juxtaposition with a light-colored or luminous surface, is not only rendered blacker than before, by the force of contrast of tone, but it is likewise slightly tinted by the complementary of the contiguous color, although it may be difficult to distinguish this tint when the black is a *deep* black.† Thus a black

* It is difficult to observe this effect upon the white unless the contiguous color is viewed intently for a few moments; because the exceeding brilliancy of the white tends to render the sight insensible to the complementary which the colored body throws upon it.

† From the principle here involved it is evident that when black is

surface placed beside red must be slightly tinted with green. On the other hand, the white rays which the red emits will produce their greatest effects, and thus tend to lower the tone of the red—that is, to cause it to assume a lighter tint—the same as though the red had received an addition of white light. Black, therefore, *lowers the tone* of any color contiguous to it. Yet when black is placed beside a luminous color, like orange, the effect of *contrast of tone*, by causing the orange to appear lighter than before, thereby renders it, by its very whiteness, all the more conspicuous. This would be very apt to be mistaken for a heightening of the color of the orange.

Let the pupil now tell the double effect—both on the black and on the color—of the following groupings:

1. Red and black. 2. Orange and black.* 3. Yellow and black. 4. Green and black.* 5. Blue and black. 6. Purple and black.*

Black is preferable to white in an arrangement with red and yellow, or orange and yellow; but it is inferior to white when associated with red and blue, red and violet, orange and blue, orange and violet, yellow and blue, green and blue, green and violet.

XI. ARRANGEMENT OF COLORS WITH GRAY.

A normal or standard gray, being a mixture of white and black, and intermediate between the two, will be more affected than either of them by being associated with colors; for it is not so dark but that it may be tinged by the complementaries of the colors; and this very tinging of the gray will make the associated colors appear the brighter. Gray may be said, therefore, to give additional brilliancy and purity to all the lighter or brighter colors, and, to some extent, even to the darker colors.

contiguous to a very *deep* color which has a light or brilliant complementary, the black may be weakened. Thus, take deep blue and black. As the blue has the effect to give an *orange* tinge to the black, the black may thereby be lightened up, or weakened.

* In the case of *orange* and black, *green* and black, and *purple* and black, it is evident that as the orange, although lowered in tone, is placed in strong contrast with black, it appears *more yellow;* that as the green is lowered in tone, *it* also must slightly incline to yellow; and that as the purple becomes lighter, it must appear *redder*.

Let the pupil now tell the double effect—both on the gray and on the color—of the following groupings:

1. Red and gray. 2. Orange and gray. 3. Yellow and gray. 4. Green and gray. 5. Blue and gray. 6. Purple and gray. 7. Crimson and gray. 8. Scarlet and gray. 9. Buff and gray.

Gray associates better than black with orange and violet, green and blue, green and violet.

Certain drapers gave to a calico printer some cloths of single colors—red, purple, and blue—upon which they wished gray figures to be printed. On the completion of the work, they complained that upon the *red* cloths he had put *green* patterns, that upon the *purple* he had put *greenish-yellow* patterns, and that upon the *blue* they were *orange-brown*. What was the probable cause of the difficulty?

The nearer colors are to being complementaries of each other, the better they associate together. Thus red and yellow, red and blue, orange and green, orange and purple, are passable; but red and orange, red and purple, green and blue, blue and purple, and other colors nearly analogous, do not assort well together. If, therefore, any colors that do not assort well together must be used in a dress, in the decoration of a room, or in a painting, some other color, or white, or black, or gray, may be used, in accordance with the principles already illustrated, to harmonize them. Thus red and orange, which injure each other, may be separated to advantage by their intermediate complementary, or by white, by gray, or by black. When any two colors assort badly together, it is *always* advantageous to separate them by white; but if the two colors are decidedly *luminous*, as is the case with red and orange, orange and yellow, etc., *black* is preferable to either gray or white, as it presents a better *contrast* than either of the others. Although gray does not associate as well as black with red and orange, it has the advantage of producing a less crude effect than white.

XII. MODIFICATIONS IN COLORS PRODUCED BY COLORED LIGHTS FALLING UPON THEM.

A series of interesting exercises might be written out by the pupil, on the effect produced upon colored fabrics or other colored objects in a room, by having *colored* light fall upon them: for example, when the colored light is occa-

sioned by stained or colored windows, or colored curtains, or when it is reflected from the colored wash or paper of the walls. Thus, in some of our city churches which have stained Gothic windows, it is curious to observe the effects produced by the light transmitted through the green, red, blue, or yellow glass. It will be found that when the *blue* light falls upon a delicate pink face, it will give it a very disagreeable purple hue; if it fall upon a face which is decidedly yellow, it will give it a sickly pale green tinge. The laws of the combinations of colors, as learned from the Chromatic Scale, will give the principles of all the effects thus produced. The following table will furnish examples; but the pupils should tell the results from the Scale alone:

Red rays	falling on	*Black*	make it appear	*Purple*-Black.
"	"	White	"	Red.
"	"	Red	"	Redder.
"	"	Orange	"	Scarlet.
"	"	Yellow	"	Orange.
"	"	Deep Green	"	Red-Black.
"	"	Light Green	"	Reddish-Gray.
"	"	Deep Blue	"	Violet.
"	"	Light Blue	"	Purple-Blue.
"	"	Violet	"	Purple.
"	"	Purple	"	Crimson.
Orange rays	falling on	*Black*	"	*Maroon*, or Chocolate.
"	"	White	"	Orange.
"	"	Orange	"	More vivid.
"	"	Red	"	Scarlet.
"	"	Yellow	"	Orange-Yellow.
"	"	Light Green	"	Yellow-Green.
"	"	Deep Green	"	Rusty-Green.
"	"	Light Blue	"	Orange-Gray.
"	"	Deep Blue	"	Slightly Orange-Gray.
"	"	Violet	"	Red-Maroon.
"	"	Purple	"	Orange-Maroon.

In a similar manner go through with the effects produced by yellow rays, green rays, blue rays, and purple rays, etc.

XIII. OF COLORS IN CLOTHING.

1. Men's Clothing.

The first important principle to be noticed here is, that a dress composed of cloths of different colors, especially if the colors are complementary, or nearly so, may be worn

much longer, and will appear better, although nearly worn out, than a suit of a single color, even when the latter is of a piece of cloth identical with either of the kinds used in the first-mentioned suit. The *cause* of this it will not now be difficult to understand.

Suppose the effect of the contrast of the two colors red and green, or red and blue, used in a suit of clothes, be to add one tenth in brilliancy to each color; and suppose that one year's wear would diminish their brilliancy one tenth, then, in the case of the two colors associated, they would have the same degree of brilliancy at the end of one year of wear, as would be presented by a *new* suit of either of the colors alone.

The increased brilliancy gained by the contrast of complementary, or nearly complementary colors, is one great advantage of forming the suits of soldiers of cloths of different colors. A dress made of cloths of different colors will not so soon *whiten in the seams* as a dress of a single color.

2. Female Clothing. Blondes.

The complexions of females of the Caucasian or white race present two types: 1st, *blondes*, with light hair and blue eyes.

In this type the color of the hair, which is more or less *flaxen*, is essentially a *very pale orange-brown;* and the color of the skin, although of a lower tone, is analogous to it, except in the red parts. Now Nature has shown an admirable regard to the harmony of colors in contrasting *blue* eyes by hues of the complementary *orange* in the hair and complexion. The *purplish-red* of the lips and the rosy hue of the cheeks beautifully modify the severity of the contrast, on principles before explained (see page 114). Thus much for Nature's regard for harmony. Nor is it now difficult to see what colors in dress best accord with the blonde type, for it must be, as is well known, *sky-blue* —that color which approaches nearest to the complementary of a pale orange.

On the same principles *delicate green* is favorable to all fair complexions that are *deficient* in *rose*, and which may have more imparted to them without disadvantage; for it not only harmonizes the sky-blue and the pale orange, but gives its complementary red to the complexion. If, however, the complexion be already *too red*, or have too much orange in it, even delicate green will be unsuitable, for what it will add will give the complexion too much of a *brick*-red hue.

We may now see, therefore, why either a *light blue* bonnet, ornamented with white flowers, and sometimes with yellow and orange flowers (but not with rose or violet flowers), or a *green* bonnet trimmed with white or rose flowers, is advantageous to fair or rose complexions.* Neither orange nor yellow bonnets are suited to blondes; and purple is unsuitable to all complexions, as there are none which are improved by having its complementary, greenish-yellow, added to them.

Rose-red, pink, maroon, and light crimson, have the disadvantage of rendering a fair complexion more or less green, and if used in a bonnet they should be separated from the skin by a border of *tulle lace*, or some similar material. Although *lustreless white* accords well with a fresh complexion, it is unsuitable for complexions that have a disagreeable tint, because white, as we have seen, exalts all colors by raising their tone. Black draperies, by lowering the tone of the colors with which they are in juxtaposition, whiten a fair complexion; but this very whitening, exerting its influence most on the whiter portions of the face, causes the rosy parts, such as the lips, to appear, relatively to the white, redder than before.

* The reason why *deep* blue and *deep* green would not be suitable to blondes is, that colors, to be complementary, must correspond in *depth of tone*. Therefore it requires a *tint* of blue or green, as light, comparatively, as the pale orange of the complexion, to be the complementary of the latter.

3. Female Clothing. Brunettes.

Brunettes, with black hair and black eyes, form the second type of the complexions of females of the white race.

Yellow, and red more or less orange, are the two colors which contrast most favorably with the black hair and black eyes of brunettes. Hence a yellow or orange bonnet suits a brunette well, and may have, for trimmings, their complementaries blue or violet, if large masses of hair separate the bonnet from the complexion. As the brunette complexion has already too much orange in it, it is evident that so much *blue* as would be presented by a blue bonnet, and which would impart its complementary orange to the complexion, would be unsuitable for this type. If a *white* bonnet be worn, its accessories may be of red, rose, orange, or yellow, but not blue.

4. The Copper-colored, Black, or Olive-colored Races.

As the copper-colored complexion of the women of the North American Indians would be disagreeably dulled or deadened by partially neutralizing it, or lowering its tone, it is better to heighten its tint. For this purpose a drapery of white may be used, on the principle that white heightens all colors; or a drapery of greenish-blue may be employed, for then the complexion will receive a still *redder* orange hue.

The olive or black complexion also appears best when heightened by contrast. To this end, if the skin be intensely black, or dark olive, or greenish-black, red is preferable to any other color. If the skin be a blue-black, orange is particularly suitable. Yellow best accords with a purple-black, as being nearest its complementary. It is not without reason, therefore, that negro women delight in red, orange, and yellow, for these colors best become them by heightening the tone of their complexion.

From the foregoing principles it will now be easy to see how the prevailing color of the complexion may be either heightened or lowered by the dress worn.

1. The prevailing tint of the complexion is heightened by a white drapery.

2. By a drapery the color of which is the complementary of the tint; such as a green drapery for a rosy complexion, or a light blue drapery for the pale orange complexion of a blonde.

3. A green drapery also heightens an orange complexion by giving it more red; and a yellow produces a similar effect.

The tint may be lowered—

1. By a black drapery, which lowers it by contrast of tone.

2. By a drapery of the same color as the tint, but of a much deeper or higher tone; such as a *deep red* drapery with a rosy complexion, or a deep orange drapery with an orange-tinted complexion; for in these cases the *deep* tones have the effect, by force of contrast, to blanch out the lighter tints of the same colors.

XIV. HARMONY OF COLORS IN NATURE.

We have noticed a few of these harmonies—in the light blue eyes and pale orange complexions of blondes—in the black hair and eyes, and darker orange complexions of brunettes—in the natural fondness of the black races for those draperies of red, yellow, and orange, which harmonize with their complexions; and we have alluded to the harmonies which prevail in the boundless variety of the subdued colors seen in vegetation, in the plumage of birds, coverings of animals, etc. We give a few more illustrations.

Green is not only the most abundant color in nature, but also the one most soothing to the eye; and it contrasts more agreeably with all colors than any other one. As green is the most general color of vegetation, so red, its complementary or harmonizing color, and compounds of red, are most general in flowers. *Purple* flowers have most commonly their centres of variegations of *yellow*, the complementary of purple; and *blue* flowers are most commonly relieved with *orange*, the complementary of blue.

Blue and green in juxtaposition are discordant, and need to be harmonized by some warm color; but as Nature never violates the laws of harmony, she interposes the warm orange hues of the horizon to harmonize the blue of the sky and the green of the landscape. We have seen that the harmonizing color of orange is its complementary, blue; and it is a singular fact, that the more the light of the sun partakes of a golden or orange hue, and the more parched and burned the earth is, the *bluer* appears the sky, as in Italy and all hot countries.

But, although this is a very interesting subject, our limited space compels us to stop at the very threshold. In connection with the subject of PAINTING, we hope to unfold more of its beauties in the Seventh Reader of the "School and Family Series."

Compositions.

As the pupils are taken by their teacher over the different portions of the preceding article on colors, they should write compositions on them, upon such plans as the teacher may suggest. Those who are sufficiently advanced should be accustomed to state not only the facts and principles presented, but, so far as they can, should give the explanations of them, with such illustrations as they can furnish. Both the harmonic and the discordant effects produced by the juxtaposition of colors in dress, in paintings, in nature, etc., will furnish a wide field for the application and illustration of principles. Let them examine and criticise paintings. Those who can obtain a copy of "Field's Chromatography," an English work, will read with interest the numerous poetical selections found there, which show that our standard poets seem to have had an almost intuitive perception of the harmony of colors. See also, on this subject of *harmony*, Calkins's "Manual."

CHART No. XV. ZOOLOGICAL: ECONOMICAL USES OF ANIMALS.

[As most of the exercises on this Chart are designed to be introduced early in the course, and are for the younger pupils, they preserve more of the "object" mode of teaching than those connected with some of the preceding Charts. As was before remarked (page 22), the Charts are not, necessarily, to be taken up in the order in which they are numbered, nor are the exercises on any one necessarily to be gone through with uninterruptedly, or in consecutive order. The teacher must regulate the exercises according to the time at his command, and adapt his plan to the ages and capacities of his pupils. The following lessons are therefore designed more as *suggestions* to the teacher than as a programme to be literally followed. See also Programme in the Appendix at the end of the volume.]

What is this a Chart of? If the pupils do not readily answer "*Animals*," lead them to it by suitable questions; and then lead them, of their own knowledge, to tell what an animal is; that is, to give a *definition* of "an animal." They will perhaps say, "An animal is any thing that *lives*." But say to them, "*Trees* live; and we talk about *live* trees and *dead* trees." This will perhaps lead them to add to their definition that "Animals are things that live and *move*." But say to them, "The *trees* move when the wind blows; and they are all the time moving, as the world moves." If now a pupil sees that animals move of their own will or accord, voluntarily, and that trees do not, he will have made out a very good definition; and besides the mental discipline it will have given him, it will in itself be worth to him vastly more than if he had been told it. Webster says, "An animal is an organized body, endowed with life, sensation, and the power of voluntary motion." Vegetables are organized bodies, and are endowed with life; but they have neither sensation nor voluntary motion.

Are birds animals? Fishes? Frogs and turtles? Flies? Grasshoppers, etc.? Yes, for they all live and move voluntarily.

The pupils should next familiarize themselves with the groups of animals represented in the twenty numbered illustrations on this Chart; and for this purpose they should first merely point them out on the Chart, and name them,

aided by the teacher if they can not do it without assistance. For example, he should tell them, pointing to No. 1, "These are domestic cattle—cows and oxen." No. 3. "These are animals of the swine kind." No. 10. "These are some of the fur-bearing animals," etc.

After this, encourage them to go to the Chart, one by one, to point out the groups, and to tell (aided by your questions in the way of *suggestion*) what they know about the animals represented. Most of the pupils will probably have some knowledge of most of the groups; the domestic animals they are familiar with; and many of the others may have been described to them from pictures, or they may have read about them, or may have seen them in menageries. Accustom them to tell freely and without embarrassment what they know of them. Next proceed with a more systematic course of exercises on the illustrations in order, beginning with No. 1.

Number 1. Cattle: Chart XV.

[Suitable "objects" to be used in connection with the lessons on this number would consist of *specimens of sole-leather*, *cow-hide*, *kip-skin*, *calf-skin*, etc.]

Can you tell what kinds of leather I have here? Examine them, and tell what they are.

What animals are represented in the engraving No. 1 on this Chart? Cows and oxen. What do you call them when you see them in the field or pasture? Cattle. The term *cattle* is also applied to horses, asses, mules, sheep, goats, and swine; but in this country its use is mostly restricted to the *ox* kind. We also speak of the ox kind as *neat* or *horned* cattle. By a series of questions, lead the pupils to tell what they know about cows and oxen—their size, color, habits, uses, etc. Cattle are from four feet to five and a half or six feet in height at the shoulders, and from six to eight and nine feet in length, from the nose to the insertion of the tail.

Tell the colors of those represented on the Chart, No. 1. How does the third cow from the front differ from the others? She has no horns. What are such cows called?

Lead the pupils to tell you that cattle are of various colors —white, black,* red, dun or dull brown, and brindle, that is, marked with varied spots; but that white, black, and red are the prevailing colors. What kind of feet have cattle? Are they like those of cats and dogs? Like those of horses? How do the feet of cows differ from those of horses? Cows, like horses, have *hoofs;* but in cows they are *cleft;* in horses they are entire or whole. Animals whose hoofs are cleft are called *cloven-footed.* Notice also the *little hoofs* of the cow on the legs and above the large hoofs. This is a horny excrescence at the posterior part of the fetlock.

When cattle are standing in the yard, or lying down, after feeding during the day, have you ever noticed any peculiar habit which they have? They chew the cud. Does the horse chew the cud? Do hogs? No. What animals, then, do chew the cud? All animals of the ox kind, such as cows, oxen, the buffalo or bison; also sheep, goats, deer, etc. All animals that chew the cud are called *ruminating* animals, because one meaning of *ruminate* is, "to chew the cud." Can you tell what this chewing the cud is, and why cattle do it?†

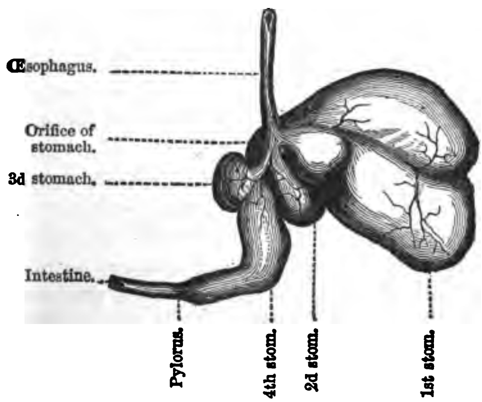
* Although *black* is, correctly speaking, the absence of all colors, yet in popular language it is called a color.

† Probably most young pupils will not know what this "chewing the cud" is, nor will they see any necessity for it. Ask them what kind of *teeth* cattle have; if they have teeth like those of the squirrel, or of the cat, dog, etc. Show them that their front teeth are made for cropping or plucking off the grass, and their back teeth for grinding it, and not for gnawing nuts, nor for seizing other animals and tearing their flesh. As their food consists of grass, and herbage, and dried hay, etc., it requires to be thoroughly chewed (masticated), which would require more time than they can give to it while they are feeding. Now see what a wise provision the Creator has made for the wants of these animals.

All the ruminating, or cud-chewing animals have a stomach of *four* cavities, instead of one as in other animals, as shown in the opposite engraving. The grass cropped by them is not chewed at once, and the dried hay only partially, but is passed directly into the *first* stomach, or paunch. (See cut. The teacher should make a large drawing of it on the blackboard, and also a drawing of the stomach of man, for which see

Does the cow chew in the same manner as the dog does? No. When the cow chews, her jaws have a sidewise grinding motion. Did you ever see the little balls come up the throat of the ox or cow into the mouth? Did you ever see them come up the throat of the horse or the hog? No. Do these animals, then, belong to the *class* of Ruminants?

What are *cows* useful for? First, their *milk;* how used? butter and cheese made of it. How butter is made; how the process of making butter is said to have been discov-



upper part of Fig. 10, page 33, Fourth Reader.) Here it is macerated or soaked, after which it is passed into the *second* stomach, where it is made into little balls. When the animal is at leisure, each of these balls is brought up into the mouth, and is chewed, after which it is passed down into the *third* stomach, and thence into the *fourth*, where the gastric juice is mingled with it, and digestion properly commences.

After giving the foregoing explanation to the pupils, ask them what *use* they suppose the young calf, lamb, etc., whose food is nothing but milk, can have for the first three stomachs. They have no grass to be soaked and to be made into balls. Did they ever see the young calf, or young lamb, chewing the cud? No. The truth is, in the suckling Ruminants the milk passes directly into the fourth stomach, the other stomachs remaining unemployed until the animal begins to graze. It is not until the tough grassy food needs the soaking and chewing to prepare it for digestion that the first three stomachs are brought into use. This is an adaptation to meet the peculiar wants of these animals.

ered.* How cheese is made.† Ordinary price of each per pound. 2d. *Flesh* for food. What is the flesh of cows, oxen, etc., called? Of calves? How beef is cooked: boiled, roasted, dried, fried, broiled, stewed for soup. Beef preserved; what *corned* beef is. Prices. 3d. The fat, or *tallow*, for candles. Process of making candles. 4th. *Hides* or skins of oxen, calves, etc. What is made of them? Leather, for a great variety of uses. How is leather made from skins?‡ What kinds of leather are obtained from the skins of cattle? *Sole leather*, from the heaviest ox-hides, used for the soles of heavy boots; *cow-hides*, used for heavy boots; *kip-skins*, from the skins of young cattle; and *calf-skins*, from the skins of calves. 5th. *Horns*: the lower part used extensively for making combs; the middle was formerly much used as a substitute for glass in lanterns; the tips are used for knife-handles, tops of whips, etc.§ 6th. *Hoofs*—glue made from, by boiling to a jelly. 7th. *Hair*—used extensively in mortar, for inside plastering. For what purpose is it thus used? 8th. *Bones*—used

* In early times, when mankind were shepherds and herdsmen, they made vessels out of skins for carrying the milk. As these vessels were borne from place to place on camels, the jolting would soon convert a portion of the milk into butter.

† *Cheese* is the curd of milk, separated from the whey, compressed into a solid mass, and dried for food. The prepared inner membrane of a calf's stomach, called *rennet*, is used for the purpose of coagulating the milk—that is, separating the curd from the whey.

‡ Describe the *tanning* process—which consists of cleansing the skins of hair, flesh, etc., and then saturating them with *tannin*, which is an astringent principle contained in the bark of certain trees and plants. Oak, hemlock, and chestnut bark are much used for tanning. The skins of animals, when prepared by merely drying them, are stiff, incapable of resisting water, and liable to decay; but the *tannin* combines with the gelatin of the skin, and forms a durable compound, which is no longer soluble in water. When the tannin is too strong the leather is more quickly tanned, but it is more rigid and more liable to crack than when the operation is slower. The best of tanning requires a period of from ten to eighteen months. Latterly our leather has been much injured by rapid tanning.

§ The handsomest combs are made of tortoise-shell. See Fifth Reader, page 60. Combs are also made of India-rubber, or gutta-percha.

extensively in making handles of knives, and for many other purposes. There are large stores near New York City which sell *shin-bones* only, of cattle and other animals, for such uses. These are mostly imported from South America. Bones, burned and ground to powder, are extensively used in sugar-refineries for cleansing or purifying sugar. Ground bones are also used as a manure, and especially around the roots of fruit-trees.

What are *oxen* mostly used for? Are they *harnessed* together? Describe the ox-yoke. On which side of the oxen does the driver walk? What is the ox near him called? The ox on the other side? What does the teamster tell the oxen when he wishes them to go to the right? When he wishes them to turn to the left? When he wishes them to stop? Price (in the neighborhood) of a yoke of oxen; of a cow. How long do cows and oxen live? From 12 to 25 years. Mention and define as many compound words as you can that have *cow* for one of the primitives. (Cow-hide, cow-house, cow-keeper, cow-herd, cow-lick, cow-leech, cow-like, cow-pox, etc.) For general description of animals of the ox-kind, see Third Reader, page 217–219.*

* *Additional Notes.*—The ox has eight incisors or cutting-teeth in the lower jaw, and none in the upper. It has no canine teeth (or tusks), but has six *molars* or grinding teeth on each side of both jaws. The teeth are represented by the following formula: Incisors $\frac{0}{8}$, canines $\frac{0}{0}$, molars $\frac{6-6}{6-6}=32$ teeth. The want of incisors in the upper jaw is a characteristic of the Ruminants.

The principal kinds or breeds of cattle known in this country are, 1st, the *Long Horns*, originally Irish, and embracing the Lancashire, Derby, and Bedford cattle; 2d, the *Short Horns*, including the Durhams, of splendid frames and beautifully varied colors, excellent for the dairy; 3d, the *Middle Horns*, including the Devonshire cattle, or North Devons, and the Herefords; 4th, the *Crumpled Horns*, or Alderney cattle, originally from France; and, 5th, the polled, or *Hornless* cattle.

The number of domestic cattle in all Europe has been estimated at 71,400,000; in the United States at 22,000,000; in the whole world at 210,000,000; and it is believed that one third of the entire number, or seventy millions, are killed annually. This would give seventy millions of skins, 140 millions of horns, 280 millions of feet, and seventy millions of carcasses, to be converted annually into beef, tallow, leather,

Oral and Written Compositions.

The teacher will see from the foregoing lessons, which are here given as *suggestions*, and not as full details, that he may make the exercises on No. 1 quite extensive, bringing in a large amount of useful every-day information. He may extend them much farther than we have. With small pupils, however, he should at first limit himself to the most obvious and best known features, uses, and habits of these domestic animals, and should gradually extend his range of instruction as his pupils are prepared for it. He should be particular to *lead them to tell* as much as possible, as a fact or principle discovered by his pupils may be considered worth, to them, *ten times* as much as if told them by their teacher. After the pupils have acquired a little familiarity with No. 1, they should individually go to the Chart, point out the objects, and *tell* as much about them as possible. They will thus gradually learn to *observe* carefully, to *think* accurately, to *arrange* or systematize their knowledge, and to *express* their thoughts in words. In such exercises will be found the proper continuation of *composition* writing from the lessons given in connection with the first six charts; and when pupils are able to write with a little facility, they should make daily use of the pen in writing what *they* have *told* or spoken. They too often begin with the attempt to write on some abstract subject, such as pride, or anger, or honesty, or education; and it is no wonder that writing compositions, under such circumstances, is a repulsive task to them. But any pupil who

combs, manure, etc. These estimates will serve to give some idea of the immense extent to which a single species of animal subserves the interests of man.

The *chest* of an ox, or other animal, is the large cavity inclosed by the breast-bone, ribs, etc.; and what is called the *girth* of an ox is the measurement around the body, just back of the fore legs.

The *brisket* is that fleshy appendage to the chest which hangs down between the fore legs.

The *dewlap* is the flesh which hangs down from the throats of cattle, and which *laps the dew* when they are grazing.

can use the pen, and who has gone over the foregoing exercises on No. 1, will be able to write a very fair composition, or several of them, about cattle.

Number 2. Horses: Chart XV.

What is this a picture of? A horse. Which do you think the handsomest, and the most graceful in his movements, the ox, or the horse? Tell as many points of difference as you can between the horse and the ox:—in general form, size, height, shape of head, ears, neck, body, legs, *hoofs*, tail, etc., and in strength, speed, docility, intelligence, etc. Mention the various purposes for which you have seen horses used.

Of what colors have you seen horses? Black, bay, chestnut, sorrel, roan, gray, and cream color, etc. *Bay* is a reddish-brown. *Chestnut* is a lighter brown than bay. *Sorrel* is a yellowish-bay, or yellowish-brown. *Roan* is black, bay, chestnut, or sorrel, with white or gray hairs thickly interspersed. Do you know any horses in the neighborhood that are black? Any that are bay? Chestnut? Sorrel? Roan? etc. The color of the horse in No. 2? When we speak of the *height* of a horse, do we say the horse is so many feet or so many inches high? We say, so many *hands* high. What is a "hand," in measure? Four inches. Where is the height of a horse measured? At the shoulders. What is considered a high horse? One that is sixteen hands high.

What sounds is the horse said to make, in the language which it uses? It *whinnies*, and it *neighs*. What kind of *shoes* does the horse wear? Who makes them? How are they fastened to his feet? Why do not the nails hurt him? Name the kinds of food which the horse eats. What quantity of oats would you give a horse at one time? What danger from his eating too much grain, or drinking too much water when he is warm? Danger that he may be *foundered*. What is the disease called the "founders?" A disease that causes a soreness in a horse's feet.

What is meant by *a pair* of horses? "A pair" of horses signifies two horses harnessed together, or in some way suited or adapted to each other. What other name is given to a pair of horses harnessed together? A span. Mention the different *parts* of an ordinary harness, and tell their uses. Do we say "a span" of oxen? What do we call a pair of oxen yoked together? A yoke of oxen. Do we call "a span" of horses, or "a yoke" of oxen, by any other name? Yes; a *team*. What is a team? A team is a *number* of oxen, horses, or other beasts, harnessed to the same vehicle, or drawing the same load. It is not strictly correct to say "a one-horse team."*

How many kinds of vehicles drawn by horses can you mention and describe? Mention as many compound words as you can that have *horse* for one of the primitives, and define them. Horse-blanket, horse-whip, horse-block, horse-boat, horse-boy, horse-breaker, horse-car, horse-cart, horse-dealer, horse-doctor, horse-fair, horse-fly, horse-hair, horse-laugh, horse-leech, horse-load, horse-pond, horse-race, etc. Can you tell any facts and anecdotes about the horse? See Third Reader, p. 191–197. Can you repeat or refer to any poetry on this subject? Third Reader, p. 198–204.

What two animals of the horse kind, besides the horse, are represented in the engraving No. 2? Two asses. What things particularly distinguish the ass from the horse? Its long ears, its tail ending in a tuft, and its peculiar bray.†

* An ingenious teacher would elicit from the pupils the answers to nearly all of these questions without actually *telling* them any thing; and he will show his skill and tact, both in his ready perception of their difficulties, and in the means which he takes to overcome them by such questions or suggestions as may be adapted to each particular case. *He must not attempt* to follow the precise course which we have marked out, as no one form and order of questions can possibly suit all cases. The teacher must make these exercises a free and familiar *talk* with his pupils.

† We read in the Bible that the patriarchs Abram and Job possessed great herds of asses. These animals are found wild at the present day in large herds in the central deserts of Asia, each band directed by a

Compositions.—These will naturally embrace such facts connected with the horse as have been elicited from the pupils, together with incidents and anecdotes with which they are personally acquainted, which have been told them, or which they have read of.

Number 3. Swine: Chart XV.

What does No. 3 represent? Wild swine—animals of the hog kind. The one in front is a wild hog of the Molucca Islands, with four immense tusks. What are the colors of hogs? For what is the hog most useful? Are there any people who do not eat the flesh of the hog? The Jews do not, because Moses interdicted the eating of swine's flesh. What is the flesh of the hog called? Pork. Any other name? What is bacon? The flesh of the hog salted and smoked. What parts of the hog are usually salted and smoked? The hams, and sometimes the shoulders. What part of the hog is the ham? The thigh.

How is pork usually preserved? How cooked?* What is the fat of the hog, when melted down, or "tried," called? Lard. For what purposes is it used? Who can

chief. Job describes the wild ass, ch. xxxv., verses 5, 6, 7, 8. The wild ass of Persia is a slender and elegant-looking creature, as fleet as the swiftest horse. It is of a cream-color, with a black mane. Its flesh is highly valued by the Persians, who consider it one of their chief delicacies.

The obstinate *mule* is a mixed breed between the horse and the ass. *Donkey* is a common name for the ass and the mule. The *zebra*, another animal of the horse kind, known by its dark stripes, is very wild and fleet, living in troops, and shunning the dwellings of man.

* Charles Lamb gives a humorous account of the manner in which *roast pig* was first discovered. He represents a Chinese youth, by the name of Bobo, as perceiving a most delicious odor issuing from the blazing ruins of his father's cottage. This he finds to proceed from one of the pigs, a whole litter of which had been roasted in the conflagration. Strongly tempted, he ventured to taste, and was entranced at the result. He now devoured all the rest of the roasted pigs, and finally set fire to a great number of cottages, so as to enjoy the repast of the young porkers baked in the blaze. At last his father discovered the secret, and ere long it was communicated to the world; and thus for ages mankind have enjoyed the most delicious of viands—roast pig.

name the most uses to which it is applied? Besides being used in cooking, it is largely used in making soap and candles, and oil for machinery. Who can tell how soap is made? How candles are made? What are the stiff hairs on the back of the hog called? Did you ever notice these bristles when the hog is excited? How did they appear then? For what purposes are these bristles used? In making brushes, etc. Name as many *kinds* of brushes as you can. Can you think of any use which the shoemaker makes of these bristles? Which end of the bristle does he fasten to his "waxed-end," and why?

Is there any thing peculiar about the tip of the nose or snout of the hog? For what does the hog chiefly employ the tip of its nose? *Why* does the hog root up the ground? Do you see any design, then, in making the tip of the hog's nose so tough and strong? Why are wires sometimes put into the hog's nose? What is this putting in twisted wires called? What is the food of the hog? What is the best food for fattening hogs? Indian corn. Can you describe the feet of the hog? The feet consist of four toes, of which the two middle ones are considerably longer and stouter than the others, forming a cloven hoof, upon which the animal walks. The two lateral toes are also furnished with hoofs, but they are placed at the back of the foot, at some little elevation from the ground. Who can tell what *souse* is?

Are the eyes of the hog large,′ or small‵? What can you say about the *habits* of the hog? What noise does the hog make when it is happy or contented? When it is in pain, or is hungry? Do you know of any use that is made of the skin of the hog? It is largely used in making saddles for horses. What is a young hog called? A *shote;* but the very young are called pigs. When a hog is killed, what is the process of preparing it for use called? *Dressing* it. Is that the ordinary meaning of "dressing"? What will a large hog weigh when dressed? From five hundred to eight hundred pounds.*

* According to the census of 1850, the number of hogs in the United

Compositions.—In accordance with previous suggestions, p. 102, 104, etc.

Number 4. Sheep: Chart XV.

[Suitable "objects" to be used in connection with the lessons on this number would consist of samples of different grades of wool, of pieces of sheep-skin variously tanned, of the principal kinds of woolen cloths, of *felt* and *shoddy*, and of parchment and vellum.]

What does the lower part of engraving No. 4 represent? A flock of sheep. How does the covering of the sheep differ from that of the ox, or the horse? Here is a little bunch of wool; how does wool differ from hair? It is softer than hair (except fur in masses), of a finer texture, more matted and curled, or twisted, and of a silky feel. What kind of feet have sheep? What kind of horns? Are sheep timid′ or fierce‵? Sagacious′ or dull‵? What is the word "sheepish" often used to designate? What is a lamb the emblem of? Innocence. And why?

What is the flesh of sheep called? What uses are made of the skin? It is made into leather, and used for a great variety of purposes; the most extensively, perhaps, for book-binding. Parchment is also made of it.* The cuttings, or

States was about *thirty millions*. It is now probably much larger. In Cincinnati alone, the centre of the Western pork market, the value of the products of the pork trade—in pork, bacon, lard oil for machinery, and in candles, hides, bristles, etc.—is said to exceed ten millions of dollars annually. During the year 1856 the number of hogs packed in Cincinnati alone was 405,396, and their *average* weight was 285½ pounds.

* *Parchment*, used for writing upon, is prepared from the skins of sheep and goats. These, after being steeped in pits impregnated with lime, are stretched upon frames, and reduced by scraping and paring to less than half their original thickness; after which they are rubbed smooth with pulverized chalk and pumice-stone, and dried for use. *Vellum*, similar to parchment, is made from the skins of very young calves. *Catgut*, used for strings of musical instruments, the cords of clock-weights, and those of some other machines and instruments, is made from the intestines of different quadrupeds, particularly those of cattle and sheep. What is called *gold-beater's skin*, between layers of which gold-beaters lay the leaves of their metal while they beat it, is an extremely fine membrane, made also from the intestines of animals.

little strips, are not wasted, but are made into glue. What are the undressed skins, with the wool on, usually called? Pelts. What are the fat portions of the sheep used for? For making candles and soap. What are the principal kinds of sheep in this vicinity? The kinds of sheep most highly prized for their wool are the pure-blooded Merinos, the Saxons, the Cotswolds, the Leicestershires, and the Oxfordshires. The South Downs are particularly esteemed for the excellence of their flesh; and their wool is valuable for many purposes, on account of the facility with which it can be wrought. How is wool sold`—by the pound′, or the fleece`? How much per pound, ordinarily? How much is ordinarily obtained from a sheep?*

What does the upper part of the engraving No. 4 represent? A sheep-washing. How often are sheep washed, and at what season of the year? Why are the sheep washed? How is their wool taken from them? Do you know what kind of shears is used? What use is made of the wool? Cloth is made of it. What is done with the wool in making it into cloth? After shearing, the wool passes through a great many processes, and is carded, spun, and then woven into cloth, either with or without being colored.† What is

* Samples of wool of different degrees of fineness and length of fibre should be obtained, and examined by the pupils until they can readily distinguish the principal grades of long wool, short wool, coarse wool, fine wool, etc. Long wool may vary in length from three to eight inches. In sorting wools there are frequently eight or ten different grades in a single fleece; but it is only the experienced wool-sorter who can distinguish all of them. It is not difficult, however, to distinguish five or six different grades from different fleeces. In the year 1850, when there were fifty-two and a half millions of pounds of wool produced in the United States, the average weight of each fleece was a little less than two pounds and a half.

† "The wool obtained from sheep becomes the means of support to staplers,[1] dyers, packers, scourers,[2] carders, combers, spinners, spoolers, warpers, weavers, fullers,[3] burlers,[4] shearmen, pressers, and clothiers, who, one after another, tumble, and toss, and twist, and bake, and boil, and pound, and press this raw material, till they have each extracted a livelihood from it; and then comes the merchant, who, in his turn, ships it, in its highest state of improvement, to all quarters of the globe, whence

the cloth called, which is made of wool? Woolen cloth. What are some of the names given to the different kinds of woolen goods? Broadcloths,[a] Petershams,[b] pilot-cloth,[c] cashmeres,[d] cassimeres,[e] kerseys,[f] tweeds,[g] tartans,[h] linsey-woolseys,[i] moleskins, doeskins, beaver-cloths, shawls, blankets, flannels, hosiery, carpets, etc. The pupils will, doubtless, be able to give many of these, and also other names. They should not be *told* any thing that may be elicited from them by questioning.

Do you know what the common *felt* hat is made of? Of wool. Is this wool either spun or woven? Hats of this kind, found in every school-room, may be examined,

he brings back every kind of riches to his country, and all in return for this valuable commodity which the sheep affords." As a good object lesson, let a pupil take a piece of woolen cloth, and trace it back through its several stages—or so many of them as he can—to the back of the sheep; and then let the teacher explain, if he can, the physiology of the growth of the wool itself.

[1] *Stapler* is a dealer; as, a wool-*stapler*.

[2] *Scourer*, one who cleanses or cleans the wool.

[3] *Fuller*, one whose occupation is to *full*, or thicken the cloth in a fulling-mill.

[4] *Burler*, one who dresses the cloth—raising the *nap* by combing it with the *bur* of the teasel, etc.

[a] *Broadcloth* is a fine kind of woolen cloth, of broad make, used for fine coats, etc.

[b] *Pe'-ters-ham*, a kind of rough woolen cloth, used mostly for overcoats.

[c] *Pilot-cloth* is a coarse indigo-blue woolen cloth, used for great-coats, and the clothing of mariners and others.

[d] The genuine *Cashmere* is a peculiar fabric made from the soft downy wool which forms the inner coat of the Cashmere goat of Thibet. The true Cashmere shawls are manufactured of this wool, but they are now well imitated from sheep's wool.

[e] *Cassimere* is a thin twilled woolen cloth, generally woven from the finest wools. It is also written *Kerseymere.*

[f] *Kersey* is a coarse woolen cloth, usually ribbed, and woven from long wool.

[g] *Tweed* is a light woolen cloth.

[h] *Tartan* is a fine worsted, silk, cotton, or mixed cloth, checked with threads of various colors.

[i] *Linsey-woolsey* is a kind of coarse cloth made of flax and wool mixed.

when it will be seen that the wool is neither spun nor woven. In this case the rough wool fibres being thoroughly intermixed and compressed in hot water, cohere and form a solid tenacious substance. This process is called *felting*. *Fur hats*, also, are made by this same process. All woolen cloths made of short wool are subjected to a similar process. They are put into a *fulling mill*, where the strokes of the mill make the fibres cohere; the cloth, subjected to this operation, contracts in length and breadth, and its texture becomes more compact and uniform. Cotton and flax can not be *felted*, because the fibres have not that jagged structure which causes the woolen fibres to cohere when firmly pressed together. Before wool can be felted it must be thoroughly freed from all oily matter, otherwise the fibres will easily loosen their hold upon each other.

Can you see the *threads* in most new woolen cloths—broadcloths, for example? Why not? What is it that covers up the threads? A downy surface, called the *nap*. Do you know how this nap is produced? By carding the cloth with a species of *burs* of the common *teasle* plant. This operation loosens from the woolen threads a part of the fibres of the wool, and lays them in a parallel direction. The *nap*, composed of these fibres, is then cut off to an even surface by the process of shearing. But it is evident that, while this process improves the beauty of the cloth, it diminishes its strength. Have you ever heard of or seen *shoddy* cloth? Do you know what it is made of? Old woolen rags, instead of being thrown away, are collected, and, after being subjected to various processes, are torn in pieces by the aid of powerful machinery, and reduced to their original state of wool; and this wool, being respun, either with or without an admixture of fresh wool, is made into a cloth called *shoddy*. Handsome blankets, druggets, carpets, table-covers, and cloth for pilot and Petersham great-coats, are either wholly or partly made of shoddy. The clothing of the English army and navy consists principally of this material. It has been said that this *shoddy*, being manufactured from articles that were formerly deem-

ed of no value, "is one of the greatest triumphs of art and civilization." Do you know what *worsted* is? It is woolen yarn or cloth, made of long wool deprived of its felting properties by passing it through heated iron combs. Therefore genuine *worsted* stockings ought not to *full up* like ordinary wool. Of what length have you found fibres of wool?*

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 5. Goats: Chart XV.

[Suitable "objects" to be used in connection with the lessons on this number would consist of specimens of red, black, green, and yellow morocco, and of kid, and fabrics made of goats' wool.]

Can you tell what kinds of leather I have here? What animals produce the skins from which this leather is obtained?

What animals are represented in No. 5? Goats. How do goats differ from sheep? Question those pupils who have seen both, about the points of difference, and see if they have observed them. The *horns* of the *sheep* are first directed backward, and then forward in a curve, while the horns of goats are generally directed only upward and backward. The horns of the upper goat in No. 5 are too much *curved*. The hoofs of the goat are higher, thicker, and more compact than those of the sheep; the false hoofs are more fully developed; head smaller and finer; ears shorter and rounded; hair long and unequal; the goat is unpleasantly odorous, while sheep are not so; the goat is curious, capricious, and bold, while the sheep has very little curiosity, is staid and timid; in fighting, the goat rears

* The census of 1850 shows that there were then 1559 woolen factories in the United States, with a capital of about twenty-nine millions of dollars, devoted to the manufacture of wool. The woolen manufactures thus produced amounted to forty-three millions of dollars; in addition to which we imported nearly seventeen millions' worth for our use. Thus we consume annually more than sixty millions of dollars' worth of woolen manufactures, or an average of $2 60 for each person in the United States.

itself on its hind-legs, and lets the weight of its body fall on the adversary, while the sheep, in fighting, runs a tilt, adding the force of impulse to that of weight; most goats have a beard, while the sheep have none.

What is the covering of goats? Some are covered wholly with hair, others with wool mixed with hair. The Cashmere goats of Thibet, from which the famous Cashmere shawls are made, are covered with a hard, stiff, coarse kind of hair, called *kemp*, under which, in the winter, is a vest of the most delicate grayish wool. Why is this fine wool found there in winter and not in midsummer? What becomes of it? What becomes of the wool on the sheep in summer if it is not sheared off? At what season of the year do animals—horses, cows, etc.—"shed their coats" the most freely? Why in the early part of summer? How does the hide look when they are shedding their coats? How after that? At what season of the year is the hair or fur of animals the longest and the most dense? Why?

How much wool does an ordinary sheep produce annually? From two to five pounds. How much of the inner coating of fine wool do you suppose a goat produces annually? Only about three ounces—about the fifth part of a pound. Do you think, then, a Cashmere shawl can be furnished at as low a price as a shawl made of sheep's wool? The price of the fine Cashmere wool, even in Thibet, is about a dollar and a quarter a pound; and a genuine Cashmere shawl is not unfrequently sold for five hundred dollars—some even for a thousand. The *kemp* or hairy covering of the goat is used in the manufacture of coarse cloth.

In what parts of the world are goats most abundant? In many parts of Asia and in Southern Europe. What uses are made of the common and wild goats? Their flesh is wholesome food; their milk nutritious; their undressed skins are the winter covering of a large part of the mountain shepherds and peasants of Europe and Asia; their tanned skins make the finest morocco, which is used for shoes, for book-binding, and for a thousand ornamental

purposes; and in France kid gloves are manufactured by millions from the dressed skins of the young goats, called *kids*. In England the lawyers, judges, and bishops wear wigs made of white goats' hair. The horns of goats make excellent knife-handles; their tallow the best of candles; and their hams, when salted, are called *rock-venison*, and are equal to those of the deer. (See also Third Reader, pages 220, 221.)

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 6. Elephants: Chart XV.

[Specimens of ivory—such as an ivory paper-folder, ivory toys, etc.]

What is this which I hold in my hand? What material is it made of? Ivory. Where do we obtain this ivory? Is it a vegetable substance, an animal substance, or a mineral substance? Lead the pupils, by questioning or by suggestions, until they discover that the tusks of the elephant are ivory; then proceed with the following.*

What animal is represented in No. 6? Probably all of you have seen the animal. Where did you see it? In a *menagerie*. What is a menagerie? A collection of wild animals. What other animals did you see there? How large do you think the elephant is? It is from seven to twelve feet high, but the average height is about eight feet. The length of the body, from the mouth to the insertion of the tail, is from nine to fifteen feet, and it weighs from 5000 to 7000 pounds. How does it compare, in size and weight, with horned cattle? See No. 1.

But the elephant seems to have no neck at all, or only a very short one. How, then, can it eat from the ground?†

* Most of the ivory of commerce is obtained from the tusks of the elephant; but the tusks of the walrus or sea-horse also furnish excellent ivory. (See Third Reader, pages 173 and 183.) The tusks of the hippopotamus and wild boar are also ivory, though it is inferior to that produced by the elephant and walrus.

† Children should not be *told* at once how it obtains its food. If *they* make the discovery, they will be far more deeply impressed with the evidences of design and adaptation than if all had first been explained to

It puts its food into its mouth with its flexible *trunk* or proboscis. How does it drink? By sucking up a quantity of water into its trunk, then putting the trunk into its mouth, and pouring, or rather *blowing*, in the water. Can you mention any other uses of the trunk? The elephant *breathes* through it and *smells* through it, as it contains the *nostrils* of the animal; and it can spout water with it quite a distance. In its native wilds it cools and washes itself by standing in the pools or streams, and spouting water all over its body. At the end of the trunk is an appendage like a finger, with which the animal can pick up an object as small as a penny. This trunk is composed of more than forty thousand small muscles, variously interlaced, flexible in all directions, and is endowed with exquisite sensibility. The trunk is also the organ of the voice, and through it the animal utters strong, trumpet-like tones.

What is the food of the elephant? Wholly vegetable: in its wild state, the leaves and branches of trees, etc.; when tame, it is fed on grass, hay, oats, bran, etc. Elephants are fond of sweetmeats, and also, in India, of *arrack*, a spirituous liquor made from rice. What are those things which project from the mouth of the elephant? Two long, tapering *ivory* tusks.* From which jaw do these come? The upper jaw. The elephant has no incisors—that is, front or cutting teeth—in either jaw. Of what length have you seen elephants' tusks? These tusks are often from six to eight or ten feet in length. One has been known fourteen feet in length. They not unfrequently weigh a hundred and fifty pounds each, but the average weight is sixty pounds. The great value of these tusks may be estimated by the fact that the largest

them. Teachers should bear in mind that the *answers* which we have given are designed to aid the teacher in making *suggestions* to his pupils *only when such suggestions are necessary.*

* The female elephants in Asia have no tusks, while in Africa both the male and the female have tusks, although those of the male are much the largest. Portions of the African elephant are eaten by the natives. The *trunk* is considered a great delicacy; and a French writer speaks of the foot as a dish "fit for a king."

ivory brings in the market about a dollar and a half a pound. It is supposed that the tusks of more than ten thousand elephants are used annually, a few of which are obtained from elephants that have died in the natural way, but most of them from elephants that have been hunted and killed for their ivory. A large trade in ivory is carried on with the African coasts. In Sheffield, England, five hundred persons are occupied as ivory workers, in making knife-handles, chess-men, billiard-balls, combs, paper-folders, mathematical and musical instruments, toys, etc. The Chinese are better workers in ivory than any other people.*

What is that placed on the back of the elephant? It is a kind of seat or carriage, called a *houdah* in India. Who is the man sitting in front, on the neck of the elephant? He is the driver or keeper of the elephant, called the *mahout*. "In India the elephant is a familiar beast. In ancient times it went to war with towers filled with soldiers on its back: it now carries traveling parties in a similar manner. Kings and princes ride upon it in state, and the animal seems to take a delight in the pomp and pageantry of which it forms a part. A strong elephant can carry a burden of three or four thousand pounds, and it will bear a thousand pounds on its tusks. It loads and unloads boats with its trunk; it pulls at a tackle; it rolls and lifts and carries barrels and hogsheads; in short, it does the work of oxen, horses, and men.†

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

* The celebrated Athenian statue of the Olympian Jupiter, made of gold and *ivory* by the sculptor Phidias, was sixty feet high. It was such a prodigy of art that it was thought by the ancients worthy to be reckoned among the seven wonders of the world.

† For farther description of the elephant—his habits, sagacity, uses, anecdotes of, etc.—see Third Reader, page 182–186.

Number 7. Camels: Chart XV.

[Specimens of camel's-hair pencils, camel's-hair cloth, etc.]

Here is a little *brush*, which you have perhaps seen used for painting in water-colors. Do you know what it is called, and what it is made of? It is called a camel's-hair pencil, and it is made of the soft hair of the camel. At what season of the year do you suppose this hair is obtained from the camel? Why in the spring, or early summer? Because then the camel, like other animals, sheds its hair. Do you know of any other use which is made of camel's hair? Is any mention made of its use in the New Testament? Yes: the raiment of John the Baptist was made of camel's hair. The Arabs at this day manufacture the hair of the camel into wearing apparel, tents, and carpets. In Southern and Western Asia, and Northern Africa, it is an important article of commerce. The French manufacture it into hats.

Where is the camel represented on this Chart? In No. 7. What kind of a camel is the upper one, with the two humps on its back? The Bactrian camel. How large do you suppose this camel to be—as large as the elephant', or as large as an ox? It is nearly as high as the elephant, being from 7 to 9 feet in height. Its length is about 10 feet. How do its body and limbs compare with those of the elephant? Is the loaded camel in front like the one above? Can you see any difference in them? The upper camel is covered with shaggy hair, especially under the throat; the lower one is not. Moreover, if the load were removed from the one in front, you would see that it has but *one* hump on its back. This is called the *Dromedary*, or Arabian camel. See Third Reader, page 205. It is not quite so large as the Bactrian camel, but is a faster traveler. If the upper camel is the largest, why is it represented, here, smaller than the other?

In what countries are camels found? What uses are made of them? In what respects are they peculiarly adapted to these warm countries? See Third Reader, page 205—

207. Are they ever found in a wild state? No: the whole race appears to have been, from time immemorial, under the dominion of man. In the Scriptures camels are frequently spoken of, not as wild animals, but as already subject to man's use. See Genesis, xxxii., 7, and xxxvii., 25; Judges, viii., 21; Job, i., 3, and i., 17, and xlii., 12, etc. Do you know what a *caravan* is? In what important respect are camels like oxen, sheep, etc.? Like the ox, the camel *chews the cud*, and is therefore called a *ruminating* animal. How does the *hoof* of the camel differ from that of the ox? It is soft, tough, and elastic, so as to yield readily to the stones of the desert; but it is not cloven-footed like the ox, the toes only being divided. In Leviticus, xi., 4, the camel is enumerated among the animals which the Israelites are forbidden to eat, "because he cheweth the cud, but *divideth not the hoof*."

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 8. Dogs: Chart XV.

What animals are represented in No. 8? What three kinds or varieties are there represented? How many different kinds of dogs have you seen? How many can you mention and describe?* What is the food of the dog?

* The principal kinds or varieties of dogs are:

1. The mastiff, a favorite watch-dog, of grave aspect, imposing appearance, and a deep, sonorous voice. He is a faithful friend, but a fierce and bitter enemy.

2. The bull-dog, of moderate size, but of great strength and courage; has a round, thick head, a turned-up nose, and thick and pendulous lips.

3. The Newfoundland dog, brought at first from Newfoundland.

4. Esquimaux dog, smaller than the Newfoundland; very useful to his master in drawing sledges and carrying heavy loads. Its ears are short and erect, and its bushy tail curves elegantly over its back.

5. The water-spaniel, which delights in plunging into water, and is of great use to the sportsman while shooting wild ducks or water-hens.

6. The Dalmatian or coach-dog, with a spotted hide, distinguished by his fondness for horses, and as being the frequent attendant on the carriages of the wealthy.

Mostly animal food; wholly so in a wild state. How, then, does the dog differ in this respect from horses, oxen, and sheep? Do you know what those animals are called which live on the flesh of other animals? *Carnivorous*, which means "flesh-eating." Then there should be some distinct name for those that live on vegetable food. Do you know what it is? *Gram-i-niv'-o-rous*, or "grass-eating."

How do the feet of the dog differ from those of the ox? The ox has a cleft hoof; the dog has *toes* to his feet and *claws*. Did you ever notice how many toes the dog has on his fore feet? Five. How many on the hinder feet? Four.* How many claws on each foot? The same number as the number of toes. Can the dog use his claws in the same manner as the cat does? Did you ever see the cat extend its claws, and then draw them back so as almost entirely to conceal them? Can the dog do this? No. The claws of the cat, and of all animals of the cat kind, including the lion, tiger, etc., are *retractile*, while those of the dog are *non*-retractile. Did you ever notice how the dog walks, whether on the sole of its feet or on the toes? It walks on its toes. So does the cat, the lion, the tiger, etc.†

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7. The blood-hound, a native of Spain, was early sent to the West Indies, where it was used by the Spanish invaders as an ally in their wars with the revolted Indians.

8. The English, Scotch, Irish, Russian, Grecian, Turkish, Persian, and Italian greyhounds.

9. The Mount St. Bernard dog, or Alpine spaniel.

10. The shepherd's dog. The muzzle is sharp, the ears are short and nearly erect, and the animal is covered, particularly about the neck, with thick and shaggy hair.

11. The old English hound, of large size, long body, deep chest; ears long, large, and pendulous; and a peculiarly deep voice.

12. The fox-hound, a much esteemed and celebrated hunting-dog in England. The beagle and harrier are also fox-hounds.

13. The setter, the pointer, the Scotch and English terriers, the King Charles spaniel, the little lion-dog, the Maltese dog, and the poodle.

* There are some species of dogs (but not among those that are common) that have five toes on their hinder feet.

† Those animals which walk on their toes are called *digitigrade*, from

What sounds do dogs make in the kind of language which they use? They bark, bay, howl, yelp, whine, moan, growl, and snarl. When and why do they bark, howl, whine, etc.? See Third Reader, page 144. For what are dogs most noted? For their sagacity, and their fidelity to their masters. Do you know of any instances of either from your own observation? Can you tell of any that you have heard of or read of? Some examples of both are given in the Third Reader, page 144–151. Have dogs the same senses that we have? Which of their senses is the most acute? That of scent, or smell. How does the fox-hound follow its prey? By scent. Do all dogs follow their prey by scent? No: the greyhound follows by sight only. Did you ever have a dog lick your hand? Was its tongue soft′, or harsh‵? Soft. Did you ever have a cat lick your hand? Was the tongue of the cat as soft as that of the dog? No: the tongue of all the animals of the cat kind—such as cats, lions, panthers, tigers, etc.—is covered with small recurved prickles, with which they are enabled to lick the last particles of flesh from the bones of their prey.

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 9. Fur-bearing Animals: Chart XV.

What are muffs and tippets generally made of? The *furs* of animals. What furs have you seen used, for these and other purposes? What animals are most noted for their furs.* What fur-bearing animals are represented on

the Latin *digitus*, a finger or toe, and *gradi*, to walk. Those which, like the bear, place the *sole* of the foot on the ground in walking, are called *plantigrade*, from the Latin *planta*, sole of the foot, and *gradi*, to walk.

* The most noted are the stone marten, the baum, or pine marten, the fitchet, polecat, or foumart; the ermine, the weasel, the Russian sable, the beaver, the raccoon, the lynx; the red, cross, silver, white, and gray foxes; the mink, the muskrat, the otter, the seal, the squirrel, the rabbit, the skunk, and the chinchilla; also, for the coarser furs, the wolverine, wolf, and bear. It is stated that *five millions* of the skins of animals applicable as furs are annually imported into Great Britain. In

the Chart? 1st. The pine marten, or American sable, found both in Europe and America; 2d, the polecat, fitchet, or foumart, of Europe and Asia; 3d, the stoat or ermine, of Europe and America; 4th, the common weasel. How large are these animals? The marten (head and body) about 18 or 20 inches in length; the polecat, 17 inches; the ermine, 11 inches; the weasel, 8 or 9 inches. How would you describe the general form or appearance of these animals? They are long and slim animals, with short legs. Do you know what the common weasel, and most animals of its class, feed upon? Rats, mice, moles, small birds, eggs, and reptiles. At what season of the year should you suppose the furs of these animals would be the thickest, the finest, and the softest? In the winter season, when this covering of fur is most needed to keep the animals warm. Which have the warmest hair or fur, small animals′ or large? Why small animals? Because they are the most delicate, and need the finest covering to keep them warm. Which are clothed the warmest‵, animals that live in cold countries′, or in warm‵ countries? Why those which live in cold countries?

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 10. Llamas: Chart XV.

What animals are represented in Number 10. What are they doing there? Ascending the mountains with burdens on their backs. Where are these animals found? What is their size? What are their uses? etc.

The llama, sometimes called the *American camel*, is found in South America, chiefly in Chili and Peru. Its native

the year 1851 nearly three millions of the skins of squirrels were imported into Great Britain from Russia alone; and it is said that *fifteen millions* of these little fur-bearing animals are every year captured in Russia. Although the trade in furs is constantly diminishing, as the fur-bearing animals become more scarce, yet the prices of furs are gradually diminishing also. The use of furs is almost wholly dependent on the caprice of fashion.

region is upon the slopes of the immense chain of the Andes. There are several species, both wild and tame. The wild llamas are vigilant and shy, living in flocks at a great altitude upon the mountains, and only descending toward the plains occasionally in search of food. The domesticated llamas, which are employed as beasts of burden, carry a weight of about a hundred pounds; but they travel slowly, going only ten or twelve miles a day. They are remarkably sure-footed, descending steep and rugged places where man can pass with difficulty. During the time of the early Spanish history of South America, it is said that three hundred thousand llamas were employed in the transport of the produce of the silver mines of Potosi alone. But civilization gradually brought with it the animals of the old continent, and now the horse and the mule have almost entirely superseded the llamas as beasts of burden in the open country, and the sheep and the goat have taken their place, in a great measure, as contributors to the food and raiment of man.

The llamas are of various colors, but black, brown, and gray are the most common. Their flesh furnishes a wholesome food; and the long woolly hair with which they are covered forms the principal clothing of the Indians. The *alpaca*, one of the smaller species of the llama, and which is never employed as a beast of burden, is highly valued for its soft silky hair or wool, sometimes a foot in length, which is woven into fabrics of great beauty. In the year 1850 about five thousand bales of alpaca wool were exported from South America to England alone.

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Representatives of some of the leading Orders and Divisions of Quadrupeds.

These illustrations are designed to aid the teacher in questioning the younger pupils about some of the leading groups of quadrupeds, before proceeding to their more systematic classification in Chart No. XVI.

Number 11. The Monkey Tribe: Chart XV.

Point out and name the species here represented. The monkeys are called *Four-handed* animals. Why? See both the fore feet and the hind feet of the gorilla. See how much they are formed like the thumb and fingers of the human hand. All the monkeys have long and flexible fingers, and opposable thumbs. The *nails* on both fingers and thumbs are invariably flat and expanded, like those of man. But though in some respects the monkeys resemble man, they are, nevertheless, all true *quadrupeds*, or "four-footed" animals, as, in a state of nature, they walk on "all-fours"—their hind feet and legs not being formed for an upright position. Their feet are all formed for grasping and climbing; and their entire structure shows that they are peculiarly fitted to be inhabitants of the trees, rather than to walk on the earth. (See Third Reader, page 89–103.)

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 12. Lions: Chart XV.

Point out and name the animals represented here. Lion, lioness, and cubs or whelps. What is the lioness doing? The whelps? The lion? Describe the lion—his head, mane, body, feet, etc. How does the lioness differ from him? Chiefly in the want of a mane. The toes of these animals are distinctly divided—five on the fore feet, and four on the hind feet—and all are armed with claws like those of the cat. What do lions feed upon? The flesh of other animals. Hence they are included in the division *Carnivorous*, or "flesh-eating" animals. A full-grown lion has immense strength: he can crush the skull of a buffalo with a stroke of his paw, and carry off the body of a man, or antelope, as easily as a cat does a rat. (See Third Reader, page 107–115.)

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 13. Cats: Chart XV.

Point out and name the animals here represented. Cat and kittens. What are the kittens doing? The cat? What group of animals, shown on the Chart, do the cat and kittens most resemble? The lions. Both belong to the same division of quadrupeds, called "the Cat Family." Cats also, as well as lions, live wholly on flesh, in their wild state, and are therefore called *carnivorous*. How do the feet of the cat differ from those of the dog? The *claws* of the cat are *retractile*, those of the dog *non*-retractile. See page 152. (See Third Reader, page 122–126.)

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 14. Rabbits: Chart XV.

What animals are represented in No. 14? Rabbits—wild and tame. Which are the tame rabbits? Those in front, that have the long ears. Of the tame rabbits, which are all of European origin, and probably descended from the wild rabbits, there are many varieties, some of which have very long ears, like those represented on the Chart. Did you ever see what is called the wild gray rabbit in this country? Can you describe it? The length of its head and body is about fifteen inches; it weighs from two and a half to three pounds; its fur is soft, and of a yellowish-brown color in summer, but in winter it has a more grayish appearance; and it lives in woods and forests, and in the thickets bordering on cultivated grounds. Does it ever make burrows in the ground? No: this animal is not, really, a rabbit, but a hare, although both belong to the same family of animals. The rabbit burrows, but the hare does not; the rabbit lives in societies, the hare lives mostly alone; the rabbit is born naked and blind, the hare is born covered with fur, and with its eyes open; and in Europe the rabbit is smaller than the hare. Both are timid and defenceless; but these seeming defects are beautifully compensated—in the hare especially—by great watchful-

ness, acuteness of the senses, and swiftness of foot. Both are exclusively vegetable feeders, and, to fit them for gnawing, have two large cutting teeth which project from the front of each jaw. They belong to the order of *Rodent*, or "gnawing" animals. Both the hare and the rabbit, pictured in the Third Reader, page 231, are the European species.

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 15. Giraffes: Chart XV.

What animals are represented in No. XV.? Giraffes or Camelopards. Have you ever seen a giraffe? Can you describe the giraffe? Head often twenty feet from the ground; two short horns on the head, covered with a hairy skin; body short, sloping downward toward the rump, and supported upon very long legs; fore legs *apparently*, but not really longer than the others; neck exceedingly long, furnished with a short mane; head comparatively small; countenance exceedingly gentle and pleasing, the eyes being remarkably full and lustrous; the ground color of the skin is yellowish, but is covered with large spots and patches of lighter and darker brown.

What kind of feet has the giraffe? Cleft hoofs, like those of the ox; but the feet are destitute of the two little accessory hoofs found in all the other ruminants except the camels. To what class of animals, then, does the giraffe belong? The ruminants. What is it that especially distinguishes the ruminants from all other animals, and why are they called *ruminants?* Should you suppose that the giraffe can eat from the ground? It brings its mouth to the ground with difficulty, and, in order to do so, stretches its fore legs widely apart. It seldom lowers its head to the ground except to drink. How, then, do you suppose the giraffe obtains its food? By browsing upon the foliage of trees; and, that it may readily grasp the young shoots, it is provided with a long and pliant tongue, which is at once a feeler, a grasper, and an organ of taste. See Chart.

What is the native country of the giraffe? Southern and Eastern Africa. (See, also, Third Reader, pages 115 and 205.)

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 16. Deer: Chart XV.

What animals are represented in No. 16? Those of the deer kind. Do you know whether all deer have horns or not? The males only have horns, with the single exception of the reindeer. There are occasional exceptions to this rule, but the cases are very rare. Unlike the ox, goat, sheep, etc., they shed their horns at regular intervals—most of them annually. What are the horns of the deer called? Frequently they are called *antlers*. Their size and the number of their branches increase with age. What does the upper figure in No. 16 represent? The English red deer or stag. This deer comes to its full growth when five years old, when each of its horns has five prongs or points, as seen in Fig. 1, No. 16. It is then called a *hart*, and the female a *hind*. When this animal is wounded and taken, it sheds tears like a child. What does the second figure represent? The English roebuck, the smallest of the English deer. Its horns are about eight or nine inches long, and each is divided into three small branches. What does the third or lower figure represent? The wapiti, American stag, or round-horned elk. It has tall, round, branching horns, sometimes six feet high; its color is yellowish brown; the tail is short; the form is stately; and the height of the animal is from four and a half to five feet at the shoulders. It sheds its horns in February or March. It might be supposed that, when pursued, the branching horns of this animal would be greatly in its way, but they are not so. The animal lays them on its back, and is able thus to force its way through the thickets with ease. (See, also, Third Reader, page 209–217.)

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 17. The Rhinoceros: Chart XV.

What animal is represented in No. 17? The rhinoceros. Is more than one kind or species there represented? Two: the one-horned and the two-horned rhinoceros. Describe the animal as well as you can from the picture of it. It is a large, uncouth-looking animal, covered with a hard, thick, naked, rough skin, disposed in large folds, especially on the neck, shoulders, haunches, and thighs. It has *three* toes on each foot. Its most distinguishing mark, however, is the solid horn on its nose or snout. One species has two horns, the smaller being directly back of and above the larger. For farther description see Third Reader, page 187.

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 18. The Hippopotamus: Chart XV.

What animal is represented in No. 18? The *hip-po-pot′-a-mus*, a word which means "river-horse." What does this animal most resemble in appearance? A gigantic hog, except in its short, thick, and very blunt muzzle. The feet have four toes, like those of the hog, terminated in as many separate hoofs. The flesh is said to be delicious, resembling pork in flavor. The eyes are situated high in the head, so that the animal, while its body is entirely covered by the water, can look around and breathe by raising but a very small portion of the head above the surface. See the lower figure. Its large teeth are very good ivory. For farther description see Third Reader, page 188, 189.

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 19. Beavers: Chart XV.

What animals are represented in No. 19? Beavers. From the appearance of their teeth, to what order of quadrupeds do they seem to belong? To the *Rodents*, or "gnawing" quadrupeds. The beaver has two incisor or

cutting teeth, and eight molar or grinding teeth, in each jaw. The incisor teeth are so very large, hard, and sharp, that they were employed by the North American Indians as implements to cut bone, and to fashion their horn-tipped spears. What do you notice very peculiar in the form of these animals? The shape of the tail, which is very broad, scaly above, and horizontally-flattened. There are five toes on each of the feet, and the hinder feet are webbed, somewhat like those of a goose. Why are the feet webbed, and what do webbed feet always show? They are webbed to enable the animal to swim the better; and webbed feet always show that the animal is designed to pass a part of the time in the water.

How large is the beaver? Head and body about three feet in length; tail about eleven inches. For what is the beaver specially noted? For building dams across streams, and for constructing its curious houses, or dwelling-places, which are always partly in the water. For what is the beaver most valued? For its fur. In the year 1788 upward of 170,000 beaver skins were exported to Europe from Canada. About 100,000 beaver skins are now annually obtained for their fur in North America alone, and considerable quantities from Northern Asia, and Northern and Central Europe. Formerly beaver furs were much used in making hats; but beaver hats have now in great part given place to hats manufactured of silk, and the cheaper fur of a little South American rodent, called the *nutria*, or coypou. Of the nutria, as many as 600,000 skins are annually imported into Great Britain from South America. In 1832 the beaver skin sold for seven dollars a pound; it now sells for about a dollar and a quarter a pound. The nutria sells for about forty cents. (See, also, Third Reader, page 232.)

Compositions.—In accordance with previous suggestions, pages 102, 104, etc.

Number 20. Armadillos and Pangolins: Chart XV.

What animals are represented in No. 20? Those above are the South American *Armadillos*, a Spanish word which means *clad in armor;* the three lower ones are the Scaly Ant-eaters, or Pangolins. The armadillos are covered, for their defense, with a bony crust, or *coat of mail*, as their name implies. This is formed of numerous many-sided plates, attached to the skin. These animals are roasted in their shells, and are considered a great delicacy by the people of South America. The Scaly Ant-eaters, or Pangolins, found in Southern Asia and Southern Africa, have also a defensive armor, which consists of numerous horny scales, implanted in the skin like nails, and overlapping each other like the tiles or shingles of a roof. For farther account of these animals, which belong to the order of "Toothless Quadrupeds," see Third Reader, pages 229, 230.

Compositions.—In accordance with previous suggestions, pages 102, 104, etc. The teacher may now also give several of the groups as the subject for a composition; or he may assign the ten upper groups for one composition, and the ten lower for another.

CHART No. XVI. ZOOLOGICAL: CLASSIFICATION OF ANIMALS.

The following exercises on this Chart are designed to give pupils merely an outline view of the various groups of animals included in the first division of zoology—the Mammalia. It is not expected that the teacher will confine himself strictly to the outline we have given, as he must be guided in this matter by the ages and attainments of his pupils. With small children, who have not read so far as the Third Reader, he may limit himself to a few *oral* lessons, taking up, first, an entire *order* at a lesson, drawing his information from the Third Reader, or from any other

source, and thus going over the entire Chart; next, he may take up, one by one, the several families, groups, or divisions, in each order; but he should rely mainly upon such *incidents* as he may gather from various sources, to give *interest* to his oral lessons, or "talks." Pupils who have *read* the Third Reader, however, may first go over the Chart in the manner we have herein designated; and in subsequent exercises they may be as minute in their descriptions as their attainments will warrant, mastering not only the groupings into orders, families, etc., but describing size, form, color, habits, etc., of each animal represented. The teacher should require them to *point out every thing* on the Chart. Although the figures there are not sufficiently large to enable the class, or school, to see each animal distinctly at a distance, they are large enough to present their general forms and groupings; and this is all that is needed here, as pupils can examine *the same* figures more minutely in their Reading-book.

What is Zoology? (See Chart, and also Third Reader, page 240.) What are the four great divisions of animals? See Chart, and Third Reader, page 240, 241. The teacher himself may give a brief explanation of these divisions in an oral lesson, or, if the pupils are reading in the Third Reader, they may be directed to read the concluding lesson, page 240, and tell what they can of these divisions, pointing out their representative drawings on the Chart. They should be required, at this stage, to *name* the classes of the *first* division only. Let the teacher describe what a *vertebrate* animal is, and then proceed with the following.

What four classes of animals are in the *Vertebrate* division? See Chart. Mammalia, Birds, Reptiles, and Fishes. To which one of these is this Chart devoted? The Mammalia. What are Mammalia? See Chart. Animals which nurse or suckle their young. What is said about including *mankind* in this division? See Chart; and Third Reader, page 87, Note.

What are the five great races into which mankind are divided? See Chart. Caucasian, Mongolian, Malay, Ne-

gro, and American. What people are included in each? In the CAUCASIAN are included all the ancient and modern Europeans except the Fins; also the Assyrians, Medes, Chaldeans, Sarmatians, Scythians, Parthians, Philistines, Phœnicians, Jews, Georgians, Circassians, Turks, Persians, Arabians, the Northern Africans, Egyptians, and Abyssinians. They have a white skin, either with a fair rosy tint, or inclining to brown; red cheeks; hair copious and black, or of the various lighter colors; eyes dark in those with brown skin; light in the fair or rosy complexioned. The Caucasian has ever been the leading and conquering race.

In the MONGOLIAN race are included the tribes and nations of Central and Northern Asia, Chinese, Japanese, Siamese, Laplanders, and Esquimaux. They are characterized by an olive color; black eyes; black, straight, strong, and thin hair, and little or no beard.

In the MALAY race are included the inhabitants of the islands of Southern Asia; of the Moluccas, Ladrones, Philippines; of Australia, and of all the islands of the South Sea. Their color is from a light tawny to a deep brown; hair black, more or less curled; head narrow, nose full and broad; mouth large.

In the NEGRO race are included all the natives of Africa not comprised among the Caucasians. Skin and eyes black; hair black and woolly; skull compressed laterally; forehead low, narrow, and slanting; cheek-bones prominent; nose broad, thick, and flat; and lips, particularly the upper one, very thick.

In the AMERICAN race are included all the aboriginal Americans except the Esquimaux. Perhaps, also, the Toltec family, which founded Mexico and Peru, must be considered an exception. Skin dark, and more or less of a red tint; hair black, straight, and strong; beard small; forehead usually low; eyes deep; face broad; mouth large; and lips rather thick.

First Class of the Vertebrates: The Mammalia.

First Order. Quadru'mana, or Four-handed Animals.

In the classification of the Mammalia, what is the First Order, and what kind of animals does it embrace? Why are they called quadru'manous, or four-handed animals? Because both their fore feet and their hind feet have thumbs and fingers which bear considerable resemblance to the human hand, and they use these four *hands* to *take hold* of things, to climb, etc. Point out on the Chart the two great divisions of the Monkey tribes. Monkeys of the Old World, and Monkeys of the New World. What are the three divisions of the Monkeys of the Old World? Apes, Monkeys proper, and Baboons. See Third Reader, pages 89, 90. What are the most noted of the Apes? The Orang-outangs. Interesting facts about the Apes. Third Reader, page 90–94. About the Monkeys and Baboons. See Third Reader, page 95–101. What can you tell about the Monkeys of South America?

Sub-order: Cheir'optera, or Hand-winged Animals.—What sub-order of animals is by some included among the Quadru'mana, or four-handed animals? Bats and Lemurs. Why? Because the BATS, which are sometimes called *hand-winged* animals, hold on to things both by their feet, and by their wings—the wings having little *hooks*, which answer the purpose of hands; and the LEMURS have thumbs and fingers on their hind feet as well as on their fore feet, very much like the monkeys. Mention some facts about the bats and lemurs. Third Reader, page 104–106.

Second Order. Carniv'ora, or Flesh-eating Quadrupeds.

What does the Second Order of the Mammalia include? See Chart. What is the meaning of Carnivorous? Flesh-eating. Point out on the Chart and name the five families or divisions of animals included in this Order. See Chart. Animals of the Cat kind, Dog kind, Weasel kind, Bear kind, and Seal kind. Point out on the Chart and name the lead-

ing animals of the CAT kind represented there. Lions, Tigers, Leopards, Lynxes, Tiger-cats, and Wild-cats. Let another pupil point out and name the leading animals of the DOG kind. Dogs, Foxes, Wolves, Jackals, and Hyenas. The hyenas are by some made to constitute a separate family. Another pupil, the animals of the WEASEL kind. Pine Marten, Mink, Sable, Otter, Ermine, Skunk, and Common Weasel. Another, the animals of the BEAR kind. Grison, Raccoon, Badger, Coati, Bear, Wolverine, Panda, and Ratel. Another, the animals of the SEAL kind. Common Seal, Sea Bear, Sea Lion, and Walrus; also, the Elephant Seal, Pied Seal, Mitred Seal, Crested Seal, and Leopard Seal.

Sub-order: Insectivora, or Insect-eaters.—What sub-order is by some included in this Second Order? Point out and name the animals of the SHREW kind represented on the Chart. The common Shrew, Oared Shrew, Hedgehog, and the Moles.

In the next place, the teacher, to vary the exercises, should point out with a pointer the carnivorous quadrupeds, in their order, beginning with the Lion, and, as he places his pointer on each, require the *class* to call its name. Then call on the pupils, individually, to tell what they can about it, such as its native country, its size, its habits, color, and any anecdotes about it which they can remember, either from the Third Reader, or from any other book.

Third Order. Ungulata, or Hoofed Quadrupeds.

What does the Third Order of the Mammalia include? See Chart. What are its three great divisions? Let the pupil point out these divisions on the Chart—the *Pachydermata*, or Thick-skinned; the *Solidungula*, or Solid-hoofed; and the *Ruminantia*, or Cud-chewing—carrying the pointer over the animals in each division. It may be remarked here, that the animals of the first *two* divisions which we have given on the Chart were embraced by Cuvier in only *one* division, the "*Pachydermata*, or Thick-skinned;" but later writers have made the two divisions which we have given on the Chart, and others still have

made a separate division for the animals of the "Swine kind." Point out and name the principal animals in the first, or "Thick-skinned" division. The different kinds or species of Hog, the American Tapir, the little Syrian Hyrax, and the South American Peccary.

Point out and name the animals of the Second Division represented on the Chart. Wild Ass, Zebra, and Horse. Point out on the chart and name the seven families of the Ruminant or Cud-chewing animals. Animals of the Camel, Giraffe, Deer, Ox, Sheep, Goat, and Antelope kinds. Now point out and name separately the leading animals of the CAMEL kind represented on the Chart. Llama, Arabian Camel, and Bactrian Camel. Of the GIRAFFE kind. The Giraffe only. Of the DEER kind. Moose or Elk, Reindeer, Java Musk Deer, common American Deer, and American Stag; also the Musk Deer of Thibet, English Fallow Deer, Bengal Hog Deer, Roebuck, and Nepaul Stag. Animals of the Ox kind. African Buffalo, Musk Ox, Zebu, the Gnu, and American Buffalo or Bison. Animals of the SHEEP kind. Corsican and African Wild Sheep, Rocky Mountain Wild Sheep, and common Sheep. Of the GOAT kind. Common Wild Goat, European Ibex, and Cashmere Goat. Animals of the ANTELOPE kind. The Gazelle, Elk Antelope, Chamois, common Antelope, and Prong-horned Antelope; also the Neel-Ghau, Chickara, Bearded Antelope, Algazel, and Springbok.

The teacher should next go over this entire Order as directed under the Second Order, page 127.

Sub-order: Edentata, or Toothless Quadrupeds.—What sub-order of Animals is by some included in this Third Order? The Edentata, or Toothless Quadrupeds. Point out and name the animals in this division. Duck-billed Water Mole, Great Ant-eater, Long-tailed Ant-eater, Cloaked Armadillo, Six-banded Armadillo, Porcupine Ant-eater, and Yellow-throated Sloth. Mention some facts concerning these "Toothless Quadrupeds." Third Reader, pages 229, 230.

Fourth Order. Rodentia, or Gnawing Quadrupeds.

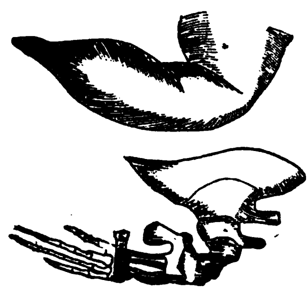
What kind of animals does the Fourth Order of the Mammalia include? The Rodentia, or Gnawing Quadrupeds. See Chart. Why is the name *Gnawers* given to them? Third Reader, page 231. Point out and name the animals of this Order represented on the Chart. Mention some facts and incidents about these animals. Third Reader, pages 232, 235.

Fifth Order. Marsupialia, or Pouched Quadrupeds.

What kind of animals does the Fifth Order include? The Marsupial, or Pouched Quadrupeds. See Chart. Point out and name the animals of this class represented on the Chart. Mention some facts about them. Third Reader, pages 236, 237.

Sixth Order. Cetacea, the Whale Tribe.

What kind of animals does the Sixth Order include? The Cetacea, or animals of the Whale kind. Why are these animals classed among quadrupeds? Third Reader, pages 238, 239.* Point out and name the animals of this Order represented on the Chart. The Narwhals† (or Sea


Flipper of the Whale.

* The whales, although belonging to the Mammals, are, indeed, destitute of both hands and feet; yet the frame-work of their *flippers* (see cut, page 238, Third Reader) is much like that of a hand, as may be seen in the accompanying drawing, representing a flipper, and also its bones uncovered. The flippers are used for balancing rather than for swimming. It is with the tail, mostly, that the whale swims. Its immense power can be judged of by its breadth, which often is twenty feet.

† The body of the narwhal is from thirty to forty feet long, and its straight pointed tusk from five to ten feet. The uses of this tusk are not well known. Some suppose it uses its tusk to dig up sea-weed for food; others, that it kills its prey with it. The Greenlanders use this tusk in the manufacture of spears, arrows, hooks, etc.

Unicorns), Greenland Whale, Spermaceti Whale,* and the Great Northern Rorqual. What is the length of the latter? More than a hundred feet. For other animals of the whale kind, see Third Reader, page 239.

Compositions.—Let the teacher assign such portions of this Chart as subjects for compositions as he may deem appropriate.

CHART No. XVII. ZOOLOGICAL.

Second Class of the Vertebrates: Birds.

This Chart is designed to give teachers and pupils a general outline *view* of the seven great orders or classes into which Birds are divided, and to present to their notice

* *Spermaceti*, obtained from the spermaceti whale, is a fatty matter, which, when separated from the oil, and purified, becomes a white, semi-transparent mass, much used for making candles. Spermaceti is found, mixed with oil, in a large reservoir in the head of the spermaceti whale. A hole is cut in the head of the whale by its captors, and this mixture is baled out with buckets, as from a well. Ten or twelve barrels of this mixture are obtained from a sperm whale of ordinary size. That waxy substance, of a musky odor, called *ambergris*, which is highly valued as a material in perfumery, is found in the intestines of the sperm whale. It is also often found floating on the surface of the ocean, in regions frequented by whales.

It is the *fat* of whales which produce the "whale-oil." This fat of the whale, called *blubber*, encases the whole animal, being mingled with the fibres of its enormously thick skin. The blubber and skin are not unfrequently two feet in thickness, and weigh in some cases thirty tons.

The whale has a curious apparatus for spouting through its nostrils, which are called "blow-holes." Under the nostrils are two large pouches, like vast bellows, which can be filled with water taken in by the mouth. When the whale wishes to spout it compresses these pouches, and expels the water with great force through the blow-holes, the outer valves of which are pushed open.

The well-known whale-bone of commerce, used principally for ribs or stretchers of umbrellas, for canes, whips, etc., and as a substitute for bristles in brushes, is taken from the upper jaw of the whale—chiefly from the Greenland whale, or from a similar whale in the Southern seas.

some leading species in each order. By locating these leading divisions as on a map, and thus presenting them *to the eye*, it is believed that pupils will learn them much easier, and with more interest, and retain them much longer, than when the same knowledge is acquired through the medium of written description only. For the mode of conducting the exercises on this Chart we refer, in addition to what is here given, to the suggestions made under the head of the preceding Chart, No. XVI. What has been given under the head of "Ornithology, or the Natural History of Birds," in the Fourth Reader of the "School and Family Series," and to which we refer, will render it unnecessary to enter into full *descriptions* here.

What are the seven *orders* into which Birds are divided? Point them out on the Chart. 1st. Birds of Prey; 2d. Perching or Singing Birds; 3d. Climbers; 4th. Scratchers; 5th. Runners; 6th. Waders; 7th. Swimmers.

First Order. Birds of Prey.

To the Birds of Prey has been given the Latin name *Raptores*, signifying robbers; and many of these birds are not only robbers, but assassins and butchers. They are distinguished by their powerful bill or beak and their claws. The former has the upper mandible longer than the lower one, strongly hooked at the tip, or curved throughout its whole length, very sharp at the point, and sometimes armed with teeth on the margins. The feet also are powerful, composed of four toes, armed with long, curved, and acute claws. See the claws and bills of the Eagles represented on the Chart. The Birds of Prey are divided into three groups or families: Falcons, Vultures, and Owls. See Chart.

1st. FALCONS.—These include the Eagles and the Hawks. See Fourth Reader, pages 84–96. If pupils have read the Fourth Reader, let them describe the Falcons, pointing to the Chart, telling size, color, habits, etc., and such anecdotes or incidents of each as they remember, or such as they have heard, or such as they have read in other books. Or, let

the teacher describe these birds, and let the pupils afterward tell what they can remember of each; or, let them write down as much as they can of what has thus been told them, and thus form a series of compositions on the subject. Let them refer to, or recite, any poetry descriptive of these birds.

2d. VULTURES. See Chart; and Fourth Reader, page 96.

3d. OWLS. See Chart; and Fourth Reader, page 97.

Let pupils tell what they can of each group or family—as to their characteristic features, species named or represented on the Chart; their size, color, habits, incidents, anecdotes, poetry, etc.; also name any birds in the country around which belong to either division.

Second Order. Sparrows, Perchers, or Singing Birds.

This order includes a great variety of birds, whose legs and feet are generally slight, and whose claws, although curved, never constitute powerful hooked talons, as in the birds of prey. The Sparrows or Perchers have four toes—three directed forward, and one backward. They have been divided into the four following groups, distinguished by peculiarities in the form of the bill:

1st. TOOTHED-BILLS.—See Chart, and Fourth Reader, pages 102–108. The peculiarity in the form of the bill is well characterized in the head of the Shrike. See Chart. Let the pupils name any birds in the country around which belong to this division. Also describe those represented on the Chart. Give poetry, etc.

2d. CLEFT-BILLS.—See Chart, and Fourth Reader, pages 108–118. For the characteristic form of the bill, see the Whippoorwill, on the Chart. Name and describe birds of this division as before directed. Poetry, etc.

3d. CONE-BILLS.—See Chart, and Fourth Reader, pages 118–129. For the characteristic form of the bill, see head of Grosbeak on the Chart. Name and describe birds of this division, as before directed. The Bobolink is the rice-bird of the Carolinas. See page 232. Not only the common Starling, but also the Hawfinch, Chaffinch, Linnet,

Goldfinch, Siskin, and Greenfinch, are European birds. There is also a beautiful American goldfinch, commonly called Yellow-bird.

4th. THIN-BILLS.—See Chart, and Fourth Reader, pages 129–133. The Humming-birds have the long and thin bills which well characterize this group. Name and describe as before directed.

Third Order. Climbers.

These birds are distinguished from the Sparrows or Perchers chiefly by the peculiar arrangement of the toes, of which two are directed forward and two backward. This enables them to climb trees with great facility. Let pupils name and describe any birds in the country around which belong to this Order. Also describe those represented on the Chart. Give poetry, etc. See Fourth Reader, page 133–140.

Fourth Order. Scratchers.

These birds, which include our common fowls, are so named in allusion to the habit of scratching in the ground in search of food. They have generally small heads and stout legs, and the males are usually adorned with magnificent colors. The wings are usually short and weak, and the flight of the birds is neither powerful nor prolonged. Let pupils name and describe as many of the birds of this Order as they can, including common fowls of different varieties—turkeys, peacocks, partridges, quails, etc. See Fourth Reader, page 140.

Sub-order: Doves.—By some the doves are included with the Scratchers. In internal structure, however, they differ somewhat from them; their wings are also usually longer and wider, and their flight rapid and long-continued. In their mode of drinking they differ from all other birds; for, instead of taking up a small quantity of water in the mouth, and then swallowing it by raising the head, they immerse the bill in water, and drink without stopping until they are satisfied. Let pupils name and de-

scribe birds which belong to this division. Poetry, etc. See Fourth Reader, page 143–146.

Fifth Order. Runners.

For description, see Fourth Reader, page 146–149. Let the pupil name and describe birds of this Order, as before directed.

Sixth Order. Waders.

For description, see Fourth Reader, page 149–154. Let the pupils name and describe birds of this Order which he has seen; also others represented on the Chart. Poetry, etc.

Seventh Order. Swimmers.

These birds are characterized by the peculiar structure of their feet, which are furnished with webs between the toes to adapt them to swimming. Let the pupil describe as many species of this Order as he can, and tell wherein they differ from each other—such as ducks, geese, swans, divers or loons, etc. See Fourth Reader, page 154.

Compositions.—After the pupils have gone over each division or group on the Chart, the same may be assigned to them as subjects for compositions. Thus the first *Order* would furnish three subjects for compositions, the second *Order* four, etc.

CHART No. XVIII. ZOOLOGY—*continued.*

Third Class of the Vertebrates: Reptiles.

The Reptiles, with the exception of a few tortoises, are carnivorous animals. They have a slow circulation; their blood is said to be cold—that is, it is but little above the temperature of the surrounding medium, whether air or water, in which they live; their movements are generally slow, crawling or swimming; their habits are sluggish; their sensations obtuse; and, in cold or temperate climates, they pass nearly the whole winter in a state of lethargy.

For a more full, general description, see Fifth Reader, page 51–54.

They have been divided by most naturalists into four orders: Chelonians, or Turtles; Saurians, or Lizard Reptiles; Ophidians, or Serpents; and Amphibians, or Batrachians.

First Order. Chelonians, or Turtles.

First Division.—LAND, MARSH, AND RIVER TORTOISES.—Let pupils name and describe such of these as they have seen, the common mud-turtles, and probably some others. Also those represented on the Chart, telling size, color, habits, etc. See Fifth Reader, pages 57, 58.

Second Division.—MARINE AND RIVER TURTLES.—Let pupils name and describe these also. Have they seen any of them? Have they eaten turtle-soup? etc. See Fifth Reader, pages 59, 60.

Second Order. Saurians, or Lizard-Reptiles.

First Division.—THE LIZARD GROUP.—Let pupils name and describe such of these as they have seen, if any. Also those represented on the Chart, telling size, color, habits, etc. See Fifth Reader, page 61–64.

Second Division.—THE CROCODILE GROUP.—What are the principal families in this group? Name and describe them: incidents, anecdotes, poetry, etc. See Fifth Reader, page 64–68.

Third Order. Ophidians, or Serpents.

What species are represented on the Chart? Describe each. How many kinds or species of serpents that you have seen can you name? How many species are found in New York and the New England states? In Britain? In Ireland? Give what farther account you can of the serpents; anecdotes, incidents, poetry, etc. See Fifth Reader, page 68–72.

Fourth Order. Amphibians, or Batrachians.

What are the principal groups of the Amphibians? Frogs, Toads, Salamanders, and Sirens. What is it that gives these animals their chief interest? The curious changes which most of them undergo—from the character of fishes in their infancy, when they breathe by means of *gills*, to the nature and habits of true reptiles at a later period, when they breathe by means of *lungs*. Did you ever see *tadpoles* or *polliwogs?* Describe them. Do you know what they become as they grow older? Did you ever watch these changes? It might be interesting for you to take a young polliwog, confine it in an artificial pond, and see what changes it passes through. Describe the Amphibians represented on the Chart. See Fifth Reader, page 72–74.

Compositions.—Let pupils write compositions about the Reptiles, one composition for each Order; and after that let them embrace the whole in one composition. Let them write as much as they can of what *they themselves* have seen.

Fourth Class of Vertebrates: Fishes.

How many kinds or species of fish can each one mention that he has seen? Write down their names. How many of these can each one describe? Describe the different *fins* of a fish. See Fifth Reader, page 227.

What are the three great leading Orders of Fishes? 1st. Spine-rayed bony fishes; 2d. Soft-rayed bony fishes; 3d. Cartilaginous fishes. Very different systems for the classification of fishes have been adopted by different writers. See the classification given by Agassiz, Fifth Reader, page 227.

First Order. Spine-rayed Bony Fishes.

What is the largest and leading family, or group, in this Order? The Perches. What species of this group have you seen? Describe as many of them as you can, as to

size, color, habit, where found, etc. Mention other groups or families of this Order. Gurnards, Breams, Maigres, Scaly-fins, Mackerel, Gobies, and Blennies. Tell what you can of each group: description, incidents, anecdotes, poetry, etc. See Fifth Reader, page 228–242.

Second Order. Soft-rayed Bony Fishes.

First Division.—FISHES WITH ABDOMINAL VENTRAL FINS.—The fishes of this division have ventral fins attached to the abdomen, *behind* the pectoral fins. What are the leading groups or families in this division? The Carp, Pike, Cat-fish, Salmon and Trout, and Herring and Pilchard families. What can you tell about the carp family? and what kinds of fish do they embrace? About the pike family? The cat-fish? The salmon and trout? The herring and pilchard family? In what family is the common shad found? See Fifth Reader, page 242–251.

Second Division.—FISHES WITH VENTRAL FINS BENEATH THE PECTORALS.—What are the principal groups or families in this division? The Cod, the Flat-fish, and the salt-water Suckers. Name some of the fish included in the cod family. What can you say of the cod-fish? Describe the flat-fish, and name some of the species. The salt-water suckers. See Fifth Reader, page 251–256.

Third Division.—THE EEL FAMILY.—These are sometimes called the *Apodal* division, or "footless" division, because they are without ventral fins; and the fins in fish are supposed to take the place of feet in the mammalia and reptiles, and of wings in birds. Let pupils tell what species or kinds of eels they have seen. Describe those represented on the Chart. See Fifth Reader, page 256–258.

Fourth Division.—FISHES WITH TUFTED GILLS.—The fishes of this division are characterized by having the gills in small tufts, instead of being comb-like. Here are found the Pipe-fishes, and that curious fish, the Hippocampus, or Hudson River Sea-horse. Describe them. All the fishes of this division have the body covered with angular, bony plates, so that the body is many-sided. See, also, Fifth Reader, pages 258, 259.

Fifth Division.—Fishes with Soldered Jaws.—These fishes are distinguished by a peculiarity in having certain bones of the head firmly united, while in other fishes they are separate. They embrace those peculiar fishes, the Balloon and Globe fishes. Describe them. See Fifth Reader, page 259.

Third Order. Cartilaginous Fishes.

The fishes of this order have their skeletons of cartilage, instead of bone. They embrace the Shark, Sturgeon, Chimæra, Ray, and Lamprey groups, or families. Describe the sharks. The sturgeons. The chimæras. The rays. The lampreys. See Fifth Reader, page 260–267.

Now let pupils recapitulate what they have been over; naming the orders, and their divisions, and pointing them out on the Chart.

Describe the *Aquarium;* the principles on which fish and plants live in it, etc. See Fifth Reader, page 268–271.

Compositions.—See the suggestions for compositions about Reptiles. Also, let them write upon the subject of the Aquarium.

CHART No. XIX. BOTANICAL.

Forms of Leaves, Stems, Roots, and Flowers.

Chart No. XIX. exhibits some of the prominent forms which vegetation assumes. Its study will be found well adapted to cultivate in children the powers of observation, as it will present to them numerous but common peculiarities in the outward forms of plants which may hitherto have escaped their notice. It will lead them to compare and contrast, and to notice differences where before they had not observed them; and it will prepare them to describe plants in intelligible language, and to understand the descriptions of others. Moreover, the forms here illustrated are not only *common things* which Nature has lavishly spread before us to please the eye, and to cultivate

a taste for harmonious variety, but they are such as must constitute, from the very nature of things, the only true and proper introduction to the study of descriptive Botany. If children were taught to notice and carefully examine whatever is presented to the eye, and were supplied with words for the ideas thus obtained, they would be found far advanced in science long before the time when they are usually thought fitted to enter upon its study. But the truth is, a very great part of science is such a knowledge of common things as children are delighted to become familiar with, and which they acquire with the greatest ease in the natural and healthful exercise of their faculties.

Children of any age may study the forms here presented, and understand them; but while studying them they should be presented, by the teacher, with the real objects from nature, that they may readily associate the representation with the reality; and when the *forms* have thus become familiar to them, they should be accustomed to illustrate them by similarly-shaped leaves, stems, flowers, etc., gathered by themselves. Children will be found to take a great interest in these forms of the vegetable world, which will supply them with an infinite variety of objects for that cultivation of the perceptive faculties which lies at the basis of all sound and truly practical education.

In going over the exercises on this Chart, pupils should describe the forms of the leaves, roots, flowers, etc., and tell wherein those that are somewhat similar really differ from each other, *before they are supplied with the words which designate these differences.* After having experienced the *need* of such words, they will be the more likely to remember them. This is also in the true order of Nature's teachings; first, the *ideas*, and then the words to *represent* them.

I. General Forms and Arrangement of Leaves.

[Specimens of net-veined leaves, with and without leaf-stalks, and stip'-ūles.]

At A, on the Chart, are shown the parts of a complete *net-veined* leaf. The leaf part proper is called the *Lamina*,

or *Blade;* the end, tip, or point of the leaf is called the *ă'-pex;* the middle vein the *midrib;* the branches from it are called *veins;* and the little branches from the latter, *veinlets.* These veinlets subdivide again and again, until they become so small as to be invisible to the naked eye. Through the fibres of the veins, veinlets, etc., the sap is carried to every part of the leaf. The *Pĕt'-i-ōle* is the leaf-stalk, connecting the leaf with the branch or stem. Some leaves have long pĕt'-i-ōles, some short, and some have none. Those which have none are said to be *sĕs'-sĭle,* or "seated." The *stip'-ūles* are two little leaves sometimes found at the base of the pĕt'-i-ōle. See Weeping Willow. Pupils should make drawings of the leaf, as shown at A, and write or print the names of the several parts. The leaves brought in as specimens should also be examined by the pupils, and their several parts and appendages pointed out and named by them.

No. 1. A *Lin'-e-ar* leaf is narrow, several times longer than wide, and with the sides nearly parallel. Examples: Saffron, Tuberose, Hemlock, Balsam Fir. Let pupils bring in samples for illustration, in every case, if possible.

No. 2. *Lan'-ce-o-late,* or "lance-shaped," is long and tapering, as the Weeping Willow.

No. 3. *El-lĭp'-ti-cal,* is oval-shaped, twice or thrice as long as broad, and with the two ends alike in width. How does it differ from the lan'-ce-o-late leaf? From the o'-vate leaf?

No. 4. *O'-vāte,* or "egg-shaped," with the broader end downward. China Aster, Flowering Almond, Water Plantain.

No. 5. *Ob-lan'-ce-o-late,* the same as lan'-ce-o-late, except that the tapering end is at the *base* instead of the apex.

No. 6. *Ob-o'-vate,* the same as ovate, except that the narrower end is downward. White Coxcomb, Smooth Alder, Daisy.

No. 7. *Cu'-ne-āte,* or "wedge-shaped," tapering downward to a point, by nearly straight lines, like a wedge.

No. 8. *Sag'-it-tate,* or "arrow-shaped," tapering upward

to a point with the base two-pointed downward. See most of the species of Sagittaria, or Arrowhead, also Field Bindweed.

No. 9. *Au-ric'-u-late*, or "eared," having two blunt projections, or *ears*, at the base. Ex. Sage; one species of the Magnolia.

No. 10. *Has'-tate*, or "spear-shaped," with spreading and pointed lobes or projections at the base. Ex. The upper leaves of Bittersweet; Sweet Potato.

No. 11. This is a common form of the *o'-vate* leaf. This is *pointed* at the apex; the other (No. 4) is rounded. Pupils can easily find leaves of this form.

No. 12. *Cord'-ate*, or "heart-shaped," having the base strongly notched or rounded in to a point, where the pĕt'-i-ole or leaf-stalk is attached. Ex. Lilac, Sunflower, Morning-glory, Catalpa. Those which are only partially cordate, as the leaves of the black walnut, sugar-maple, red maple, and apricot, are called *sub*-cordate. *Ob-cord'-ate* is *inversely* heart-shaped, that is, having the strong notch at the apex instead of the base. Ex. Catnip, leaflets of Wood-sorrel.

No. 13. *Ren'-i-form*, or "kidney-shaped," like the cordate leaf, but rounder, and broader than long. Ex. White Snake-root, or Wild Ginger (*Asarum Canadense*), and Blood-root.

No. 14. *Pelt'-ate*, or "shield-shaped," generally roundish, or orbicular, and having the leaf-stalk attached near the centre of the lower surface of the leaf, instead of the base. Ex. Nasturtion, Mandrake, Water-shield or Water-target (*Brasenia peltata*), Sacred-bean (*Nelumbium luteum*), Castor-oil Plant.

No. 15. *Lobed* and *sin'-u-ate*, a leaf having *rounded incisions* extending about half way from the margin to the midrib. The parts separated by the incisions are called *lobes*. Ex. Post-oak. The separated parts in the *cleft* and *parted* leaves (Nos. 16 and 17) are also called lobes.

No. 16 *Cleft*, when the incisions extend half way down or more, and are *sharp*. Ex. several species of Oak. The

radish leaf, which is cleft, is called *lyrate*, because the end lobe is largest and rounded.

No. 17. *Parted*, when the incisions *nearly* reach the midrib, or the base of the blade, as in No. 28.

No. 18. *Divided*, when the incisions extend quite to the midrib, or to the leaf-stalk, as in No. 29.

No. 19. *Pin'-nate*, or "feathered," having little leaves, called *leaflets*, arranged on the sides of a main leaf-stalk, in the form of a feather. These are compound leaves, and some of them have an odd leaflet at the apex, some have a tendril there, and some have neither. Ex. Senna, Locust, Rose, Pea, Parsnip. Sometimes the little leaflets themselves become pinnate; and the whole may be twice-pinnate, thrice-pinnate, etc. In the Honey-locust we sometimes see the pinnate, bi-pinnate, and tri-pinnate leaves curiously combined. Children may find abundant examples of these pinnate leaves, which they should compare, and tell wherein they differ. Ex. Bladder-senna.

No. 20. *Pal'-mate*, or dig'-it-ate, are those in which the leaflets, borne on the very tip of the leaf-stalk, are separated by deep divisions so as to represent the *palm* of the hand with the fingers. A palmate leaf is, properly, a *five*-fingered leaf, as in the Ohio Buck-eye (*Æsculus glabra*); but the term is also applied to a leaf with any number of divisions. Some Lupines have nine or eleven leaflets, the Horse-chestnut has seven, the Clover three, Monkshood three to five, Hemp five to seven.

No. 21. *Per-fo'-li-ate* leaves are those in which the stem appears to run through the blade of the leaf near one end, as in the Bellwort (*Uvularia perfoliata*). Generally the upper leaves become less and less perfoliate. In some species of the Solomon's Seal the leaves are *clasping* around the stem, having at first sight the *appearance* of being perfoliate. See, also, Opium Poppy.

No. 22. *Connate-per-fo-li-ate*, or doubly perfoliate leaves, are those in which the broad bases of opposite leaves are grown together, so as to represent one round leaf with the stem running through its centre. Ex. The true Honeysuckles.

No. 23. *Eq'-ui-tant*, or *straddling*, in which each outer leaf covers the next inner one, like the leaves of the Iris, or Flower-de-luce. It was from their straddling over each other, like a man on horseback, that the botanist Linnæus gave them this name.

No. 24. *Whŏrled*, when there are three or more leaves in a circle or *whorl*, on one joint of the stem. Ex. Red Lily.

No. 25. *Opposite*, when there is a *pair* of leaves on each joint of the stem, and one is directly opposite the other. Leaves are *alternate* when only a single leaf appears at each joint; and in this case the leaves are really arranged in a spiral form around the stem.

Nos. 26, 27, 28, 29. *Three-lobed*, *Three-cleft*, *Three-parted*, and *Three-divided*. These have also the *palmate* form, because the incisions all point to the summit of the leaf-stalk, or base of the leaf, like the fingers of the hand. Those directly above them on the Chart have the *pinnate*, or feathered form, because the incisions all point toward the midrib, and are therefore similar to a *feather* in their arrangement. The Red or Soft Maple, and the Sugar-maple have the leaves palmate, *five-lobed*, and cordate, or sub-cordate, at the base.

Spelling.—1st. The younger pupils, after examining these forms of leaves on the Chart, and noticing their names, may form these names on the frame, with the Type Letter-cards.

2d. Others may write or print them on their slates, or on the blackboard.

3d. These words may also be used for a regular spelling lesson; the pupils now being required to *define* them, having already obtained ideas of their true meaning.*

Drawing.—1st. These forms of leaves will furnish good

* The practice of requiring pupils to spell and define long lists of words, of whose meaning and use they are otherwise ignorant, we regard as an inversion of the order of Nature, by placing *words* before *ideas*, and hence opposed to the "development" or "object" method of instruction. We doubt if it is ever desirable, even for advanced students, to learn the meaning of words before there is any occasion for their use.

drawing exercises for the younger pupils, while the practice of copying them will do much to fix their outlines in the memory. See page 53.

2d. After a pupil has made drawings of these from the Chart, he should draw from Nature, selecting similarly formed leaves for his copies.

Composition.—Let the pupils write compositions under this head, describing the general forms and arrangement of leaves, and, in particular, describing leaves which they themselves have obtained—where they obtained them, the kind of tree, incidents, etc.

II. Forms of the Margins of Leaves.

[Leaves to illustrate these *forms* should be brought in by the pupils.]

Those leaves which have their general outline completely filled out, so that their margin is an even line, as in Nos. 1, 3, 4, 5, 6, etc., are said to be *entire*. Ex. Quince, Lilac, Lily.

No. 30. *Ser'-rate*, or "saw-toothed," is when the margin is cut into sharp teeth, like those of a saw, and pointing *forward*. Ex. Thorn, Apple, Pear, Peach, Almond, Hemp, Hickory, many of the roses, etc.

No. 31. *Dent'-ate*, or "toothed," when the teeth point *outward* instead of forward: as in the Red Beech, where they are coarsely toothed, and in the White Beech, where they are slightly toothed. See, also, Witch-hazel, Horehound, Hydrangea, Primrose, etc. If the teeth are very fine the margin is said to be *den-tic'-u-lāte*, as in the Pumpkin, Gourd, Squash, Cardinal-flower. If the teeth are themselves toothed, it is *doubly dentate*.

No. 32. *Crē'-nate*, or "scalloped," when the teeth are broad and rounded. The margin of No. 14 is slightly crenate. Ex. Hollyhock, Daisy, Cowslip, Scarlet Geranium. When the notches are very small, it is called *cren'-u-late*.

No. 33. *Re-pand'*, *undulate*, or *wavy*, when the margin forms a wavy line, bending slightly inward and outward. Ex. Deadly Nightshade.

No. 34. *Sin'-u-āte*, or "deep-curved," having deep rounded openings, as seen in the leaves of the White Oak.

No. 35. *In-cis'ed*, "cut," or "jagged," when the margin is divided, often irregularly, by deep and sharp incisions.

[Spelling, drawing, and compositions, as before directed.]

III. Forms of the Apexes, or Ends of Leaves.

[These should be illustrated by specimens.]

a. *Acū'-min-ate*, when the apex is prolonged into a narrowed or tapering point.

b. *A-cūte'*, when the apex is an acute angle merely—less tapering than the other.

c. *Ob-tūse'*, when the apex is blunt or rounded.

d. *Trun'-cāte*, when the apex appears as if cut off square. Ex. Tulip-tree.

e. *E-mar'-gin-ate*, having a small notch at the end.

f. *Ob-cord'-ate*, inversely heart-shape, so as to resemble a cordate leaf (No. 12) inverted.

g. *Cusp'-i-date*, tipped with a sharp and rigid point.

h. *Mu'-cro-nāte*, very abruptly tipped with a short point. Ex. Wild Senna, Balsam Fir, Willow Oak. *Yarrow* has the marginal *divisions* linear, toothed, and mucronate.

IV. Curiosities of Leaves.

For the pitcher-shaped leaves and their uses, and the leaves of the Venus's Fly-trap, see Fourth Reader, pages 194, 195. For the magnified section of a leaf—the breathing pores, etc.—see page 193. There are two strata or layers of veins in a leaf, the one belonging to the upper, and the other to the under surface. The veins of the upper stratum convey the sap from the stem (see Fourth Reader, page 181) into the blade of the leaf, for the purpose of having it there brought in contact with the air, and formed into the different materials which are required in the growth and nourishment of the tree; and the veins of the lower stratum convey the sap into the *bark*, through which it is carried wherever needed. If the leaves of a tree be stripped off, so that this process of suitably *preparing* the nourishment can not be carried on, the tree will soon *starve* to death. On this subject the teacher should read the lesson on "Cell Life," Fourth Reader, page 178.

V. Frequent Forms of the Stems of Plants.

[Let pupils bring in as many varieties of these forms as possible.]

All these forms of the stems of plants exist in nature; but it will perhaps be sufficient for pupils to learn their names as they find similar stems, and compare them with the figures here given.

When a stem rises vertically, it is said to be *erect*. When it grows horizontally upon the surface, it is said to be *procumbent*, *creeping*, *trailing*, etc. A stem is *climbing*, or *scandent*, when it rises by clinging to other objects for support—whether by *tendrils*, as do the pea and grape-vine, by their *twining leaf-stalks*, like the morning-glory, or by *rootlets*, like the ivy. The stem, like the root, is *annual*, when it lasts but one season.

An *annual herb* flowers in the first year, and dies, root and all, after ripening its seed. Ex. Mustard, Buckwheat, etc., and a great variety of flowering plants.

A *biennial herb* grows the first season without blossoming, survives the winter, flowers and ripens its seed the second season, and then dies, root and all. Ex. Turnip, Carrot, Beet, Cabbage, etc.

A *perennial herb* lives and blossoms year after year, but dies down to the ground, or near it, annually.

A stem is said to be *herbaceous* when it dies down to the ground every year.

All trees, herbs, shrubs, etc., are called *plants*, in botanical language.

A *shrub* is a small perennial plant, having a woody stem which divides into branches at or near the ground.

A *tree* is a larger perennial plant than a shrub, with a woody stem, or trunk, which does not divide into branches near the ground.*

* On this subject of the "Stems of Plants," see Fourth Reader, page 186–191; Gray's "How Plants Grow," pages 5, 23, 27; Gray's Lessons in Botany, pages 21, 36, 37; Wood's Botany, page 30–41, etc.; and Lindley's Elements, page 20, from which our diagrams are taken.

VI. Forms of the Roots of Plants.

Fig. 1. A sprouting seed. See Fourth Reader, page 183.

Fig. 2. A sprouting seed—the corn—farther advanced, with a single *rootlet.*

Fig. 3. The sprouting corn still farther advanced, having a cluster of *fibrous* or thread-like roots.

Fig. 4. A seedling of the maple, natural size. At *a* is shown the tip or end of the root magnified.

Fig. 5. A *tū'-ber-ous* root. A *tuber* is defined to be a "thickened portion of a *rootstock.*" Botanists, therefore, call the tuber of the potato a part of the subterranean or underground stem of the plant. This part of the stem is provided with buds called *eyes,* from which new plants arise the succeeding year.

Fig. 6. A *cŏn'-ic-al* root is one that thickens most at or near the crown, and tapers regularly downward to a point, as in the common beet, parsnip, and carrot.

Fig. 7. A *turnip-shaped,* or *nā'-pi-form* root, is one that is very much thickened above, and abruptly slender below.

Fig. 8. A *spindle-shaped,* or *fū'-si-form* root, is thickest at the middle, and tapering at both ends. Ex. Radish.

Fig. 9. The clustered tuberous roots of the dahlia.

Fig. 10. The *corm,* or solid *bulb,* though commonly considered a root, is merely a short and thick *rootstock.* These rootstocks grow more in width than in length, and send out buds or bulblets, which in time grow into new bulbs at the expense of the old one. The *real roots* of these bulbs, or rootstocks branch out below them. Ex. Crocus, Tulip, Hyacinth, Leek, Onion, Indian Turnip.

Fig. 11. A *runner* is a slender and prostrate branch, rooting at the end, or at the joints. Ex. Strawberry.

VII. Forms of Flowers.

[Flowers to illustrate all of these forms can usually be obtained in the summer season.]

Fig. 1. *Sal'-ver-shāped*[1] (säv'-er-shāpt), having a slender tube which spreads suddenly into a flat border, as in the phlox and cypress vine.

[1] The botanical term is *hy-po-cra-ter'-i-form.*

Fig. 2. *Wheel-shaped*, or rō′-tāte, same as sal′-ver-shaped, except that there is no tube, or only a very short one. Ex. Potato, Bittersweet.

Fig. 3. *Fun′-nel-shāped*,[1] shaped like a funnel, or tunnel; when the tube opens gradually into a swelling border. Ex. Tobacco, Morning-glory.

Fig. 4. *Bell-shaped*,[2] when the tube is wide for its length, and the border a little spreading, like a bell. Ex. Canterbury Bell, Harebell.

Fig. 5. *Cross-shaped*,[3] consisting of four pĕtals[a] spreading at right angles to each other. This is a large class of flowers. Ex. Mustard, Radish, Sweet Alyssum, Candy-tuft, Water-cress, Rocket, Wall-flower, Stock, Cabbage, Turnip.

Fig. 6. *Pink-shaped*,[4] a co-rol′-la[b] consisting of pĕtals, each having a long claw inserted in a tubular cālyx.[c]

Fig. 7. *Lily-shaped*,[5] like the lily, consisting of six parts, each gradually bending outward, so as to resemble the "bell-shaped." (In the bell-shaped the corolla is *entire*, or mon-o-pet-al-ous—of one petal: in the lily-shaped it consists of several petals.) Ex. Lily, Tulip, Crown Imperial.

Fig. 8. *Butterfly-shaped*,[6] a curiously-shaped co-rol′-la of five dissimilar pĕtals, which has been likened to a butterfly; but the resemblance is not very obvious. At *b* is another of the same kind, but a little differently shaped. Ex. Pea, Bean, Locust, Vetch, etc. A large class of plants.

Fig. 9. *Lip-shaped*,[7] having the co-rol′-la deeply cleft into two irregular parts called *lips*. Ex. Catnip, Sage, Horsemint, Snapdragon, Toad-flax, Monkey-flower, etc. If the lips are widely separated they are said to be *rin′-gent*, or "grinning," as in the monkey-flower; if they are pressed together they are said to be per′-son-āte, or "masked," as in the snapdragon.

Fig. 10. *Tū′-bu-lar*, or trumpet-shaped, when simply form-

[1] *In-fun-dib′-u-li-form.* [2] *Cam-pan′-u-late.* [3] *Cru′-ci-form.* [4] *Car-y-o-phyl-lā′-ceous.* [5] *Lil-i-a′-ceous.* [6] *Pa-pil-io-na′-ceous.* [7] *Lā′-bi-āte.*

[a b c] The teacher should by this time explain what is meant by pĕt′-als, co-rŏl′-la, and cā′-lyx. See Fourth Reader, pages 218, 219.

ing a tube in the shape of a trumpet, without the swelling border which characterizes the funnel-shaped corolla. Ex. Trumpet-creeper, Trumpet-honeysuckle, the Bignonias.

VIII. Forms of Flower Stems.

[Specimens of as many of the following flower-clusters as can be obtained should be provided for the examination of the pupils.]

Fig. 1. A *ra-cēme′* is a flower-cluster with single-flowered flower-stalks[a], arranged along the sides of a general flower-stem[b]. Ex. Currant, Lily of the Valley, Choke-cherry, Barberry, Shepherd's Purse, Hyacinth. A raceme whose flower-stalks branch into additional flower-stems, is called a *pan′-i-cle.* Ex. Oats, Chess, most of the grasses.

Fig. 2. The *cŏr′-ymb* is a flower-cluster in which the flower-stalks originate at different points along the main stem, and elevate all the flowers to about the same height. Ex. Wild Thorn, Hawthorn.

Fig. 3. A *spike* is a flower-cluster like a ra-cēme′, except that the flowers are *sĕs′-sĭle*—that is, have no stems or *pĕd′-i-cels.* They are *seated* along the main flower-stem. Ex. Mullein, Plantain.

Fig. 4 is a *spike* also, in which the sĕs′-sĭle flowers are more conspicuous; but the arrangement is the same in both.

Fig. 5. A *cat′-kin*, or *ăm′-ent*, is a spike, each of whose flowers is covered with a scaly leaf or *bract*, as in the Willow, Poplar, and Birch.

Fig. 6. An *um′-bel* is a flower-cluster whose flower-stalks, or pĕd′-i-cels, of nearly equal length, spring from the same, or nearly the same, point, so as to resemble, when spreading, the rays of an umbrella, whence the name. When the pĕd′-i-cels branch out at the top, so that each becomes the support of a smaller um′-bel, these smaller um′-bels are called *ŭm′-bel-lĕts*, and the whole a *compound um′-bel.* Ex. Carrot, Parsnip, Cicuta, Celery, Caraway, Onion, Milkweed, Primrose, Fennel, Sweet Cicely, Corian-

[a] These single-flowered stalks are called *pĕd′-i-cels.*

[b] This general flower-stem is called a *pe-dŭn′-cle.*

der. (Let the pupil examine these, and tell which are simple and which are compound umbels.)

Fig. 7. The um'-bel of the Carrot.

Fig. 8. The um'-bel (slightly irregular) of the English Cowslip.

CHART No. XX. BOTANICAL: THE CLASSIFICATION OF PLANTS.

We have already given, in connection with Chart No. XIX., representations and descriptions of the forms of leaves, stems, roots, and flowers—of the latter, however, only as respects the *general* forms of their *pĕtals* or *flower-leaves.* It is now desirable for pupils to carry the "object" system of investigation in plants still farther, by a more minute examination of the several parts which compose a complete flower, as a knowledge of these parts is required before they can understand either of the leading systems which have been adopted in the classification of plants. In no other department of science can the "object" or *Development* system of instruction be carried out more satisfactorily than in the study of the Vegetable Kingdom; and this study, as here directed to be pursued, will be worth all the time devoted to it for the mere cultivation of the perceptive faculties alone.

We have selected, on the Chart, for an illustration of the several parts of a complete flower, a species of the Evening Primrose (*Œnothera fruticosa*), as it has a flower complete in all its parts, and is found growing wild, in sterile soils, from New England and the Western states to the Gulf of Mexico. Several species of the common Primrose (*Œnothera biennis*) are cultivated in gardens, as an annual, flowering from June to August; and these also may be used for illustration, as they do not differ in important particulars from the one we have selected. As many of them, however, blossom in the evening and wither the next day, they should be gathered for examination ear-

ly in the morning. Each pupil should have, if possible, a flower of the primrose to examine, while also referring to the illustration on the Chart. If the primrose can not be obtained, take some other flower, even if the pĕtals, stāmens, and pistils are not the same in number as in the primrose.

Cālyx.—In the Primrose there is a green *cālyx*, or *cup*, which incloses the yellow flower-leaves. This cālyx is four-cleft. Where the cālyx has several separate leaves, each is called a *sĕpal.** On the Chart the cālyx is represented as divided into four green sĕp′-als, which are turned down. In the primrose the cālyx early falls off, and is therefore said to be *deciduous.* Let pupils examine flowers, and point out the cālyx, and tell whether it is entire, or cleft, or composed of several separate sĕpals. In a few flowers there is no cālyx, as in the Tulip, Lily, Adder-tongue, Tuberose, and Hyacinth.

Pĕtals.—The primrose has four yellow pĕt′-als or flower leaves. These are seen on the Chart, at the left, most of the green cālyx having been taken off to show the pĕtals the better. Let the pupils take off the pĕtals, one by one, from the real flower. Within these pĕtals are seen other organs. Let pupils examine other flowers, and see whether the corolla (flower) is entire, or consists of several pĕtals.

Stāmens.—In the stalk represented on the right the cālyx is turned down, and the pĕtals are removed, so as to present a better view of the central organs of the flower. Here are eight slender stalks or *filaments*, each of which has at its summit a little knob called an *anther.* The anther and filament taken together constitute what is called the *stāmen.* A stāmen, enlarged, is shown at the extreme left of the flower. It will hereafter be seen that the num-

* Webster prefers the pronunciation sĕp′-al, Worcester sē′-pal. In like manner lexicographers differ as to the pronunciation of *petal*, some giving pĕt′-al, and others pē′-tal. We prefer both sĕp′-al and pĕt′-al, because the compounds are invariably pronounced with the short sound of the vowel—mon-o-sĕp′-al-ous, pol-y-pĕt′-al-ous, etc.

ber of stāmens varies greatly in different plants. Let pupils examine flowers of different plants, and count their stāmens.

Pistils.—It will be noticed that within the stāmens of the primrose is a central and stouter stalk, having its summit four-cleft. This is called the *pistil.* The top of it is called the *stigma,* and the slender stalk which supports it is called the *style.* In the case of the primrose this style extends down below the cālyx, through the stalk of the plant, to the vessel or pod which contains the seeds. The seed-vessel or ovary, the style, and the stigma all make up the pistil, as is shown in the separate figure of the pistil on the Chart. The number of pistils differs in different orders of plants. Under the head of the several Linnæan classes, on the Chart, we have generally presented but *one* pistil to each class, in order to make the distinction plainer between pistils and stāmens.

The *ovary* or seed-vessel is in most plants within the cālyx, at the bottom of the flower. It is sometimes only one-celled, and sometimes many-celled, to correspond with the number of styles.

The top of the stāmen, called the anther, is almost always yellow, and contains a fine yellow powder, called *pollen.* The little grains of the pollen, when magnified, present different forms in different plants. A representation of the magnified pollen of the primrose is shown on the Chart. (For a farther account of the several parts of the flower, see Fourth Reader, pages 217–220, 223, 224.)

I. THE LINNÆAN SYSTEM OF CLASSIFICATION.

In the system of classification of plants adopted by the celebrated Swedish botanist Linnæus, the CLASSES are founded upon the circumstances of the number, position, relative length, and union of the *stamens.* These classes are then subdivided into orders. The ORDERS of the first 12 classes are determined by the number of *styles* (or stigmas when the styles are wanting); of the 13th class, by the covering or nakedness of the seeds; of the 14th, by the shape of the

pods; of the 15th, 16th, 18th, 19th, and 20th, by the number or union of the stamens; of the 17th, by peculiarities in the *florets* of the compound flowers. The classes only, and not the orders, are represented on the Chart.

Although the Linnæan system has now, in great part, given place to the natural method *for the classification* of plants, yet every botanist must understand all the several parts and all the characteristics of plants, which the Linnæan system so beautifully unfolds; and in no way can they be better learned than by going through the Linnæan system in regular order, where the materials are at hand for that purpose. Moreover, for the great ends of "object" teaching—the formation of habits of close observation, nice discrimination, and searching analysis—the Linnæan system of studying plants is invaluable. It is also the proper introduction to those grander beauties and harmonies of the vegetable world which are unfolded in the natural method of classification.

Pupils should commence the study of the several parts of flowers with the Chart before them, and with the real flowers also, and both should be made use of by the teacher for illustration. It is not necessary to take up the Linnæan classes *in order;* but the teacher should commence with such classes as he can obtain flowers to illustrate. By proceeding in this manner he may be able to go over most of the classes in one summer. The teacher should not object to introducing his pupils to this study because he himself may know nothing of botany; for the course pursued here is one of *observation* merely, and not of dictation: it is to be expected that he can observe, and remember, and learn as well as his pupils; and where he thus goes along with them in their studies, he may perhaps be the better enabled to stimulate their zeal and secure their confidence. He may perhaps be so ignorant of flowers as to know but very few of those whose common names we have given; but as in every neighborhood, and especially in the country, some flowers are cultivated, and some wild flowers are so common that every body knows them, the pupils will be

likely to bring in a considerable number of such as may be easily referred, by their names only, to their respective classes. With such the study can be commenced; and once commenced in childhood, it will be apt to be continued through life.

Class I.* *One Stamen.*—To illustrate this class obtain, if possible, specimens of some of the following plants in blossom: arrow-root, ginger, water chickweed or starwort, blite, samphire, tick-seed. Some of these have one pistil, and belong to the first order in this class; others have two pistils, and, consequently, belong to the second order. Plants of this class are not numerous. On the Chart the *stamens* are colored yellow; the pistils have a darker, or orange color. Both pistils and stamens of plants in the same class differ much in form, and a variety of these forms is given on the Chart. The *anthers* of stamens differ much in shape; and sometimes a pistil has no apparent stigma, and sometimes it has a stigma only, and no style.

Whatever plants the pupils bring in as specimens, let them examine and describe, first, the călyx, and tell whether it is entire or merely cleft, or whether it consists of many *sĕpals;* 2d, let them describe the corolla (or flower), and tell whether it is entire, or consists of several *pĕtals.*

Class II. *Two Stamens.*—It will be easy to obtain specimens of this class: such as lilac, catalpa, sage, jessamine, fringe-tree, rosemary, American olive, speedwell, horse-balm, prim, etc. All those mentioned are of the first order—that is, have only one pistil. The figure on the Chart represents the pistil coming up between the stamens. This is because the stalk of the plant is cut away below the bottom of the flower. The pistils and stamens are not united.

Call the attention of pupils to the fact that all the flowers which we have mentioned in the second class are *one-pĕtaled;* and also let them see that the pĕtals are inserted at the very base of the pistil, and *below* the ovary. Petals thus situated are spoken of as being *inferior.*† These

* The first twelve classes are named by prefixing Greek numerals to *andria*, a Greek derivative used metaphorically for *stamens*. Although these names are given on the Chart, it is not necessary, nor desirable, that young pupils should learn them at present. It is sufficient for them now merely to name the classes, by numbers, and tell their characteristics, leaving the Greek names of the classes and orders to be learned at a later period in their studies, if they should then find it desirable.

† By some the Greek word hy-pog′-y-nous (g soft) is used, from *hu′po*, "under," and *gu′ne*, "pistil"—"under the pistil."

things may appear unimportant in themselves, but they will lead pupils to examine carefully, and notice small differences, thus forming the habits of the scientific investigator.

Class III. *Three Stamens.*—This is a much larger class than the second, and embraces such plants as the gladiolus, crocus, iris, valerian, wheat, rye, oats, barley, millet, Timothy grass, red-top, sugar-cane, broom-corn, etc. Here is a great variety for examination and comparison. Some, like the wheat, have their flowers in *spikes*, and have no proper corolla.* In many of them, also, as in the illustration on the Chart, the pistil is short and knob-like, and has no *style*. In the wheat the pistil becomes the berry.

Class IV. *Four Stamens.*—Obtain, for illustration, some of the following plants: teasel, Venus's pride, partridge-berry, scabious, madder, dog-wood, which have their flowers *superior*—apparently inserted *upon* the ovary, and are of the first order; witch-hazel, of the second order; holly, and pond-weed, of the fourth order.

Class V. *Five Stamens.*—This is a very large class of plants. Among those of the first *order* (that is, those that have but one pistil), having *one-petaled* flowers, are lungwort, stone-seed, hound-tongue, borage, bugloss, comfrey, primrose cowslip, mullein, morning-glory, tobacco, phlox, Greek valerian, azalea, potato, red pepper, lobelia, trumpet honeysuckle, and four o'clock. Among the *five-petaled* flowers of the first order are jewel-weed, violet, spring beauty, bachelor's buttons, grape, currant, and gooseberry. In the second order (two pistils) will be found gentian, ginseng, carrot, sweet cicely, dill, fennel, caraway, celery, parsley, coriander, and the elm-tree. In the third order (three pistils) are snow-ball, elder, and sumach; and in the fifth order are spikenard and flax. Some of these plants have their corollas inferior, some superior; and some have their flowers in *umbels*. This class will therefore open to pupils an extensive field for investigation. Some of the flowers are small, and will require very close attention.

Class VI. *Six Stamens.*—In the first order of this class are spider-wort, pappoose root, barberry, amaryllis, leek, garlic, onion, cives, pickerel-weed, snowdrop, jonquil, daffodil, lily, adder-tongue, bellwort, Solomon's seal, asparagus, hyacinth, tulip, yucca, crown imperial, and sweet-flag; in the second order is rice; in the third order are false wake-robin, dock, and field-sorrel.

Class VII. *Seven Stamens.*—This is a very small class, and we can mention only a few common plants that belong to it, such as chick winter-green, a little plant three or four inches high, and little buck-eye and horse-chestnut, trees thirty or forty feet high. All of these belong to the first order.

Class VIII. *Eight Stamens.*—Among those that belong to the first

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* A *corolla* is not an essential part of a flower, as a flower, botanically speaking, can consist of stamens and pistils alone, and as these are all that are necessary for the production of the *seed*. See Fourth Reader, page 218.

order in this class are scabish or tree primrose, willow-herb, cranberry, fuchsia or ear-drop, clarkia, maple-tree, heath, mezereon, and nasturtion. In the third order are water pepper, buckwheat, heart's-ease.

Class IX. *Nine Stamens.*—A small class. In the first order are sassafras, spice-bush, and camphor-tree. In the second, several species of eriogonum. In the third, rhubarb. The rhubarb has no călyx.

Class X. *Ten Stamens.*—In the first order are cassia, wild indigo, Judas-tree, and rhodora, which have *papilionaceous* flowers (see page 187, Fig. 8); prince's pine, Labrador tea, rue, pride of China, mahogany-tree, and Venus's fly-trap, which have *many-petaled* flowers; and bearberry, whortleberry, trailing arbutus, laurel, and rhododendron, which have *one-petaled* flowers. In the second order are hydrangea, saxifrage, soapwort, pink, and sweet William; in the third order are bladder campion, catch-fly, and starwort; in the fifth order are mouse-ear chickweed, cockle, wood-sorrel, and live forever; and in the tenth order is the phytolacca, or poke-weed. This latter plant, therefore, has ten stamens and ten pistils.

Class XI. *Over Ten Stamens inserted on the Calyx.*—Here will be found a new character for classification—the *position* of the stamens. By pulling off the calyx the stamens will be found adhering to it. Among the plants of this class, and in the first order, will be found the numerous cactus plants, the cherry, plum, peach, apricot, pomegranate, and myrtle. In the fifth order—that is, having *five* pistils—will be found the common thorn-bush, mountain ash, the pear, apple, and quince, and those beautiful flowering shrubs the spiræas. In this class are also found the rose, in its numerous varieties, the strawberry, blackberry, raspberry, and the potentillas or five-fingers. Some botanists include these in the *thirteenth order* of this class, as all of them have a *great many* pistils. Where these pistils are, are afterward found the little seed berries that make up the large berry or fruit. The rose, in its natural or wild state, has only five pĕtals, but these are greatly multiplied by cultivation, the nŭmerous stamens of the wild flower being changed by culture into pĕtals. See Fourth Reader, page 223.

Class XII. *Many Stamens, inserted on the Receptacle;* that is, on the summit of the flower-stalk which supports the pistil or pistils. See Chart. —In the first order of this class are found the bass-wood, portulacca or purslane, celandine, blood-root, water lily, pond lily, cohosh, poppy, tea, orange, lemon, the common mandrake, and the curious side-saddle flower. In the second order is the larkspur; in the third are the mignonette and peony; in the fifth are monk's-hood, wild columbine, and St. John's wort; and in the thirteenth order—having a great many pistils—are the clematis or virgin's bower, American cowslip, hellebore, magnolia-tree, tulip-tree or white-wood, ranunculus or crowfoot, etc.

Class XIII. *Four Stamens; Two long, and Two short.*—In some plants of this class two of the stamens are abortive—mostly or wholly wanting. The plants of this class are also peculiar in having labiate or lip-shaped flowers. See page 187, Fig. 9. In this class are two orders: *gymnosperms*, or naked-seeded plants; and *angiosperms*, or those which have covered seeds. In the first order will be found spearmint, peppermint, pennyroyal, bluc gentian, hyssop, catmint, horehound, ground ivy, motherwort, lavender, savory, marjoram, skullcap, thyme, balm, and vervain. In the second order are yellow coxcomb, eye-bright, beech-drops,

figwort, bignonia or trumpet-flower, blue-hearts, snapdragon, monkey-flower, toad-flax, gerardia or false foxglove, and digitalis or garden foxglove.

Class XIV. *Six Stamens; Four long, and Two short.*—All the plants in this class are pod-bearing, and have *cruciform* or "cross-shaped" flowers. The class has two orders: 1st Order, *siliculosa*, length and breadth of pod nearly equal; 2d Order, *siliquosa*, pod much longer than broad. In the first order are sea-rocket, shepherd's purse, pepper-grass, horse-radish, water radish, honesty or satin-flower, woad, and candy-tuft. In the second order are tooth-root, wall-cress, tower mustard, water radish, wall-flower, stock-judy-flower, rocket, radish, mustard, cabbage, and turnip.

Class XV. *Filaments of the Stamens united in one Set*, surrounding the Pistil, and often appearing attached to it.—The *orders* in this class depend upon the number of *stamens*. In the third order are blue-eyed grass, tamarind, and tiger-flower; in the fifth are passion-flower and stork's-bill; in the seventh, pelargonium or stork geranium; in the tenth, crowfoot geranium or crane's-bill; in the thirteenth (having *many* stamens united), common mallows, marsh-mallows or hibiscus, hollyhock, and common cotton.

Class XVI. *Filaments of the Stamens united in two Sets.*—The orders depend upon the number of *stamens*. In the fifth order is corydalis or colic-weed; in the sixth are dielytra, fumitory, snake-root, and flowering winter-green; in the tenth are the common pea, sweet pea, vetch, wistaria, locust-tree, bladder senna, indigo, liquorice, clover, and bush clover. The lupine, dyer's broom, furze, and peanut are usually placed in the sixteenth class, but their numerous stamens are united in one set.

Class XVII. *Anthers united; Flowers compound.*—The *filaments* of the stamens are usually five, and separate. As these are usually small flowers clustered together in heads, it requires close examination to observe the several parts of any one little flower. There are two kinds of flowers or *florets* in a single head of these compound flowers—the outer being called *ray* florets, and the inner *disk* florets. Of these compound flowers there are the five following orders:

1st Order. *Equalis* (or "equal"), having perfect florets; that is, each floret, whether in the ray or the disk, having both pistils and stamens. In this order are succory or endive, dandelion, lettuce, vegetable oyster, burdock, thistle, artichoke, and boneset.

2d Order. *Superflua* ("superfluous"), having the disk florets perfect (both stamens and pistils), while the ray florets contain only pistils. In this order are tansy, artemisia, wormwood, life everlasting, elecampane, aster, golden-rod, ox-eyed daisy or chrysanthemum, garden daisy, marigold, May-weed, chamomile, and yarrow.

3d Order. *Frustranea* ("frustrated" or useless), having the disk florets perfect, while the ray florets have neither stamens nor pistils. In this order are sunflower, bur marigold, coreopsis, bluebottle, rudbeckia, and the numerous centaury plants.

4th Order. *Necessaria*, the disk florets having stamens only, and the ray florets having pistils only. In this order are ragged-cup, leaf-cup, pot marigold, and ragwort.

5th Order. *Segregata* ("separated"), each floret, whether in disk or

ray, having its separate calyx. In this order are elephant-foot and globe-thistle.

Class XVIII. *Stamens on the Style of the Pistil.*—The orders depend on the number of stamens. In the first order are the orchis, scrofula-weed or rattlesnake-leaf, snake-mouth, tway-blade, coral-root, and the arethusa—the latter a low beautiful plant of a purple color, found in wet meadows and swamps. In the second order is the cypripedium or lady's slipper. In the fifth order are the common milkweed, dwarf milkweed, butterfly weed, dogbane, and milkvine. In the sixth order is birthwort; in the tenth is wild ginger or white snake-root.

Class XIX. *Stamens and Pistils in separate Flowers on the same Plant.*—The orders depend on the number of stamens. Some of these plants have no calyx, some have no corolla, and some have neither calyx nor corolla. In the first order are found wild caper and spurge, sea eel-grass, and river nymph; in the third order are the common cat-tail or reed-mace, bur reed, sedge, sweet fern, and Job's tear; in the fourth are pipewort, alder, nettle, mulberry, and box; in the fifth, false spurge, the amaranths and coxcombs, and the common hogweed or pigweed. The latter has no corolla. In the thirteenth order (many stamens) are arrow-head, Indian turnip, water arum, burnet, and the following trees: oak, hazel, beech, birch, chestnut, hornbeam, button-wood, hickory, butternut, and black walnut. Belonging to this same class, and having their stamens *united* in one, two, or three sets, are the cucumber, musk-melon, water-melon, gourd, squash, pumpkin, the castor-oil plant, and the pine, cedar, and arbor-vitæ trees.

Class XX. *Stamens and Pistils in separate Flowers and on different Plants.*—The orders depend on the number of stamens. In the second order are the numerous species of willow, ash, and horn-bush; in the third is the fig-tree; in the fourth, the bay-berry and mistletoe; in the fifth, the prickly ash, common hop, hemp, and spinach; in the sixth, sarsaparilla, common green-brier, yam-root, and honey locust; in the eighth, poplar, balm of Gilead, and date plum; in the *fifteenth*, in which the stamens are united in one set, red cedar and yew.

Class XXI. The plants of this class, *which have no visible flowers*, are divided into six natural families or orders, as given under the Natural Method of Classification. They are, 1st, Ferns; 2d, Liverworts; 3d, Mosses; 4th, Lichens; 5th, Fungi; 6th, Algæ, or Sea-weeds.

Compositions.—Let pupils write descriptions, from time to time, of the plants which they have obtained and examined: let them describe their floral organs; color of the flower; time of blossoming; whether fragrant or not; height of plant; where found—whether in the open fields or woods, on dry and high lands or in wet places; whether cultivated or wild; if any use is made of it; whether climbing or trailing, or a shrub, or a tree, etc.; and let them connect with their notices of the places where they found them descriptions of scenery, incidents, etc.

Pupils should very early begin the collection of *herbariums*—dried specimens of plants. For directions, see page 201.

II. THE NATURAL METHOD OF CLASSIFICATION.

These Lessons are designed more particularly for those pupils who have read, or are reading, the Botanical Part of the Fifth Reader. They will also be found useful to the teacher, as guides and suggestions, with the aid of the Chart, in giving a series of *Oral Lessons* on Plants, even to the younger pupils who have not read so far, or to the whole school.

[Chart No. XX. before the pupils: on the teacher's desk pieces of oak, walnut, or some other coarse-grained wood, sawed across, to show the circles of yearly growth, to illustrate the *Exogenous* plants; pieces of corn-stalk, ratan,[1] stems of lily, and grasses, for the *Endogenous;* and, for the *Cryptogamous*, ferns, pieces of toad-stool, and puff-balls, moss from the woods, and lichens from old wooden rails and rocks, all of which may be obtained at any season of the year. The pupils also should obtain and bring in specimens.]

1. Let some pupil go to the Chart and show how plants are arranged in three great divisions, in the Natural Method of Classification. Let another similarly arrange the specimens on the table. Describe Ex-ŏg′-en-ous[2] plants, En-dŏg′-en-ous[3] (see Fourth Reader, pages 176 and 187, and Fifth Reader, pages 144 and 186), Cryp-tog′-a-mous (Fifth Reader, pages 144 and 196).

FIRST DIVISION. EX-OG′-EN-OUS PLANTS.

[Have specimens on the table.]

2. The general character of Exogenous plants being now well understood, let some one point out on the Chart the two *classes* of these. Let another divide the specimens on the table into these two classes, another name them, another describe the An′-gi-o-sperms,[4] and another the Gym′-no-sperms.[5] (See Fifth Reader, page 144, verse 2.)

[1] The *ratan*, from which walking-sticks are made, and other species of reeds, growing in great variety in India, belong to the *Palm* family.

[2] From the Greek *exo*, on the outside, and *genao*, to produce.

[3] From the Greek *endon*, within, and *genao*, to produce.

[4] From the Greek *aggeion*, a vessel, and *sperma*, a seed.

[5] From the Greek *gumnos*, naked, and *sperma*, a seed.

CLASS I. ANGIOSPERMS (COVERED SEEDS).

[Specimens of Polypetalous, Monopetalous, and Apetalous plants on the table.]

[For specimens of the An′-gi-o-sperms take the various pods, and any other covered seeds, and for the Gym′-no-sperms take cones of the pine, hemlock, larch, etc. In the larch and pine, each of the scales of the cone, when ripe, may be seen to have, on its inner face, next the base, two or more *ovules*, or seeds. The scales of the cone are the real *pistils* of the plant.]

3. Let one pupil go to the Chart and point out and explain the first division of Exogenous plants (the *Polypetalous*,[1] Fourth Reader, page 219, and Fifth Reader, page 150, Def.). Let another point out and explain the second division (the *Monopetalous*,[2] Fourth Reader, page 219, and Fifth Reader, page 167, Def.). Let another point out and explain the third division (the *Apetalous*,[3] Fifth Reader, page 178, Def.). Let another arrange, and similarly explain, the specimens on the table. Let the teacher continue the exercise by handing various specimens to the pupils, and requiring them to describe them. Thus, one says, "This is a *polypetalous* plant, because each flower has *many* pĕtals." "This is *monopetalous*, because each flower has but *one* pĕtal." "This is *apetalous*, because its flower has stamens and pistils only, and *no* pĕtals." Then give them a sunflower, thistle, aster, or marigold, etc. (of the composite family), and see if they can tell whether the flowers are polypetalous or monopetalous. They will be apt to call them polypetalous. Show them (or, better still, let them find out) that each flower-head is composed of a great many flowers, or *florets*, and that each one of these is *monopetalous* (Fifth Reader, page 164). Having thus examined some one plant in this family, let them select others, and see if they can find the separate florets. While doing this they will probably observe that most of the flower-heads contain *two kinds* of florets, or they may have learned the same in connection with the Linnæan classes: tell them the central are called *disk* florets, and the outer

[1] Polypetalous, from the Greek, *polus*, many, and *petalon*, a pĕtal.

[2] Monopetalous, from the Greek, *monos*, one, and *petalon*, a pĕtal.

[3] Apetalous, from the Greek, *a*, which gives a negative meaning, and *petalon*, a pĕtal.

ones *ray* florets. Let them tell to which *order* each plant belongs, in accordance with the Linnæan system. (See page 154.) This is a good exercise to cultivate close observation. Let a pupil point out on the Chart, and name the seven families of Polypetalous plants there represented. The six families of Monopetalous plants there represented. The four of the Apetalous.*

4. As it would be attended with too great expense to color, in the Fifth Reader, the numerous species of plants represented there, and as the colors add much to a correct understanding of them, the same species are represented colored on the Chart, to which the pupil can refer, so that he may thereby have all the advantages of the coloring. And although the figures may be thought to be too small to be seen *by the class* at a distance, yet if they have previously read over the descriptions in the Fifth Reader, or studied the names, color, and height from the Chart, the colored figures, though small, will answer very well, especially when *specimens* also are used.

5. For example: suppose the lesson of the day is about the Composite family. Have some specimens of that family on hand, if possible; but whether you have or not, send a pupil to the Chart, and let him point out and name No. 1, the *Tall Thistle.*. The next pupil in the class tells its height; the next, the color of the flower; the next, why it is monopetalous; another, why it is exogenous; another, why it belongs to the class angiosperms; another, to what Linnæan class it belongs, and why. Let another pupil then go and point out some other species (taking up the real flower also, if you have it), and go through in this, or a similar manner, with as many plants as you have time for. Then call upon the class for any *facts* which they can remember about the plants of this family; poetry, etc.

The following abbreviated lessons are given as merely a general guide to the teacher after these suggestions. They will answer, also, as a synopsis for *oral lessons* to the

* These are by no means *all* the families that belong to these divisions, but the most prominent ones.

younger pupils who have not yet advanced to the Fifth Reader.

6. We would here suggest the importance of teaching pupils to preserve plants, and collect *Herbariums* of their own. A quantity of old newspapers, two boards, each about one foot wide and 18 inches in length, and a heavy stone for a weight, are all the apparatus needed. Upon several thicknesses of paper lay down several plants, with the leaves and flowers neatly spread out; then additional paper and plants, in successive layers, upon these; place the whole between the boards, with the stone upon the upper board to press them. They will require fresh paper daily for a week; after that, as they become drier, they will not require changing so often. The plants should be labeled, with their names (if they can be obtained), and the time when they were gathered; and after they are thoroughly dried they should be attached to sheets of white paper. These preserved specimens will be found useful in conducting the following exercises when fresh specimens can not be obtained.

It would be an easy matter for every *teacher* to collect, during a single season, an Herbarium of several hundred species. For the method of ascertaining their *names*, where they are not already known, we must refer to such works as Wood's, Lincoln's, Eaton's, or Gray's Botany, etc. Each person should collect several specimens of each plant, that he may enlarge his collection by exchanging with others.

7. **Polypetalous Plants.**—Point out and name the species of the ROSE family represented on the Chart, tell their ordinary height, and color of their flowers.* Do you know any other species in this family?† To what class in the

* The Fifth Reader gives, additionally, the scientific name of each plant, the time of flowering, and native country. These facts should be required, except in a few instances, from *advanced* pupils only, who have paid special attention to the study of Botany.

† Such as Michigan or prairie rose, eglantine or sweet-brier, yellow rose, dog rose, white rose, tea rose, etc.; also strawberry, blackberry, raspberry, potentilla or cinquefoil, etc.

Linnæan system do all of these plants belong? Eleventh class. Let the pupils examine and tell if they can, and why. Over ten stamens *on the calyx.* Mention some facts about the Rose family. (Fifth Reader, pages 147–150.) Some poetry. (See Fifth Reader; or the selections may be made from any other book.) Who wrote that poetry?

8. Point out and name the species of *Common Fruits* of the Rose family represented on the Chart—tell their height, color of flowers, etc. To what class in the Linnæan system do they belong? Eleventh. Why? What other species of fruits of this Rose family can you mention?* Facts about the "Common Fruits." (Fifth Reader, page 151–153.) Poetry. Who wrote it, etc.

9. What very important plant in the CAMELLIA family? Tea-plant. Facts about it. Important plant in the MALLOW family? Cotton-plant. Facts about it. Point out and name the fruits of the CITRON family represented on the Chart—their height, color of flowers, etc. To what Linnæan class do the Camellias belong? Fifteenth. Why? The Mallow plants? Fifteenth class. The Citron plants? Twelfth. Why? Because the flowers have over ten stamens on *the receptacle;* that is, they come out directly from the top of the flower-stem. See Chart. Poetry about either of these families.

10. Point out the CACTUS family on the Chart. To what division does it belong? Exogenous. Why? To what class in the Exogenous division? Class of Angiosperms. Why? To what division of the Angiosperms? The Polypetalous division. Why?†

Point out and name the species of CACTUS plants repre-

* Wild black cherry, choke cherry, and numerous varieties of the English cherry; many kinds of plums, peaches, apples, pears, etc. Let pupils name as many *kinds* of apples as they can—which are winter apples, etc.—which they like best—describing their qualities. For the manner in which new kinds are produced, and favorite kinds preserved by budding and grafting, see Fourth Reader, page 213. Give statistics of the apple crop in the county, state, etc. See Census Reports.

† Similar questions should occasionally be asked about the several families, until the divisions and classes are well understood.

sented on the Chart—tell their height or length, and color of flowers. To what class, in the Linnæan system, do they belong? Eleventh. Why? (See Chart.) Same class as the Rose family. Mention some facts about the Cactus family. (Fifth Reader, page 158–160.) Poetry, names of authors, etc.

11. What are LEGUMINOUS plants? (Fifth Reader, page 163, Def.) Point out and name the plants of this family represented on the Chart, and tell their ordinary height, and color of their flowers. What other plants of the Leguminous family can you mention? (See Fifth Reader, page 161. Specimens should be exhibited.) To what Linnæan class do the Lupine, Corol-tree, and Locust-tree belong? Sixteenth class. Why? Because the stamens are united in two sets. See Chart. To what Linnæan class does the Sensitive-plant belong? Fifteenth. Why? What facts can you mention about any of these Leguminous plants? (Fifth Reader, pages 162, 163.) Poetry. Who wrote it? etc.

12. What are UMBELLIFEROUS plants? (Fifth Reader, page 163, Def.) Point out and name the plants of this family represented on the Chart, and tell their ordinary height, and color of their flowers. To what Linnæan class do they belong? Fifth. What other plants of this family can you mention?* To what family does the Ivy belong? Facts about the Umbelliferous plants. Poetry. Who wrote it.

13. **Monopetalous Plants.**—What are the *Monopetalous* plants? (Fifth Reader, page 167, Def.) Name the families of this division represented on the Chart.

Point out and name the species of the COMPOSITÆ family represented on the Chart, and tell their ordinary height, and color of their flowers. To what Linnæan class do they belong? Seventeenth. Why? What other species of this family can you mention?† Facts about these plants. (Fifth Reader, page 164–167.) Poetry.

* Parsley, caraway, fennel, sweet cicely, coriander, cicuta, anise, golden Alexanders, etc.

† A large number: golden-rod, vegetable oyster, burdock, eupatorium,

14. Point out and name the species of the JESSAMINE family represented on the Chart, and tell their ordinary height, and color of their flowers. Linnæan class? Second. Facts about this family. (Fifth Reader, page 168.) Poetry.

15. Point out and name the species of the HONEYSUCKLE plants, height or length, color of their flowers. Linnæan class? Fifth. Facts. Poetry. (Fifth Reader, pages 168, 169.) Describe the upper leaves of the Trumpet Honeysuckle. (*Connate-perfoliate.*)

16. Point out and name the species of the HEATH plants, height, color of flowers. To what Linnæan class do the Heaths proper belong? Eighth. Facts. Poetry. (Fifth Reader, page 169–171.)

17. Point out and name the species of the LABIATE plants represented on the Chart, their height, color of flowers. To what two Linnæan classes do these plants belong? Second and thirteenth. Why are these called *Labiate* plants? (Fifth Reader, page 172.) Other species of Labiate plants.* Some facts about the Labiate plants. (Fifth Reader, page 172.) Poetry.

18. Point out and name the species of the TRUMPET-FLOWER plants represented on the Chart, length or height, color of flowers. Linnæan class. Thirteenth. Facts about this family. As the most conspicuous of the Trumpet-flower plants are the Bignonias, all the plants of this family are sometimes called *Bignoniads*.

Apetalous Plants.—What are *Apetalous* plants? (Fifth Reader, page 178, Def., and verse 1, Les. XVI., same page.) Name the families of this division represented on the Chart.

19. Point out and name the species of the OAK family

boneset, asters, daisies, zinnias, elecampane, ox-eye, chamomile, Mayweed, yarrow, feverfew, coriopsis, bur marigolds, groundsel, wormwood, tansy, life everlasting, fireweed, pigweed, bachelor's button, saffron, garden artichoke, succory, endive, hawkweed, dandelion, etc.

* Spearmint, peppermint, blue gentian, common sage, rosemary, sweet marjoram, summer savory, hyssop, pennyroyal, skullcap, catnip, ground ivy (Gill-over-the-ground), motherwort, etc.

represented on the Chart, and tell their ordinary height.* Linnæan class. Nineteenth. Facts about the trees of this family. (Fifth Reader, page 175–178.) Poetry.

20. What tree of the ELM family is represented on the Chart, and to what height does it grow? To what Linnæan class does it belong? Fifth. What other trees of the Elm family can you mention?† Facts about the Elms. (Fifth Reader, pages 179, 180.) Poetry.

21. Point out the trees of the WILLOW family represented on the Chart, and tell their ordinary height. To what Linnæan class do the Willows and Poplars belong? Twentieth. What other trees and shrubs of the Willow family can you mention?‡ Facts about the Willow family. (Fifth Reader, pages 180, 181.) Poetry.

22. Point out the two species of the BIRCH family represented on the Chart, and tell their ordinary height. To what Linnæan class do they belong? Nineteenth. What other species of the Birch family can you mention?§ Facts about the Birch family. (Fifth Reader, pages 181, 182.) Poetry. What is the shape of the leaf of the Canadian Poplar? Cordate or sub-cordate. Of the Weeping Willow? Lanceolate; also *acuminate* or pointed, and *serrate*, or notched like the teeth of a saw. Shape of the leaves of the English Elm? Ovate, with serrated edges. Draw specimens on the blackboard.‖

* The name *mast* is given to the fruit of the forest trees generally—such as nuts, acorns, etc.

† White elm or American elm, slippery or red elm, river elm, and the Southern or Wahoo elm. For a full account of the elms, see Brown's Trees of America, page 479–513.

‡ They are numerous — such as basket willow, white willow, shrub willow, creeping willow, rose willow, bog willow, black willow, gray willow, shining willow, yellow willow, heart-leaf willow, etc.; and of the *poplars*, the common Lombardy poplar, white poplar or American aspen, birch-leaf poplar, cotton-wood, etc.

§ Yellow birch, 60 to 80 feet high; red birch, 30 to 50 feet; canoe birch or paper birch, 60 to 70 feet high—referred to in Longfellow's Hiawatha; and several species of dwarf birch—mere shrubs. See Wood's Botany, page 648.

‖ Be careful, in a *serrated* leaf to make the notches *point forward* toward the apex of the leaf, as the teeth of a saw point forward.

CLASS II. GYMNOSPERMS (NAKED SEEDS).

What name is given to the second class of the Exogenous plants? Why? (Fifth Reader, page 185, Def.) What large family composes this class? The Cone-bearing family.

Point out and name the species of the CONE-BEARING family represented on the Chart, and tell their ordinary height. To what Linnæan class do most of them belong? Nineteenth. Why? To what Linnæan class do the Red Cedar and common Yew belong? Twentieth. Why? Some facts about the trees of this family.* (Fifth Reader, page 182–184.) Poetry.

SECOND DIVISION. ENDOGENOUS PLANTS.

[Specimens of numerous varieties should be exhibited.]

What are Endogenous plants? How do they grow? etc. (Fourth Reader, pages 176, 187, and Fifth Reader, 144, 186.) Describe the two classes into which they are divided. (See Chart, and Fifth Reader, pages 190, 195, Def.) What families are included among the *aglumaceous* plants? (Chart.) Among the *glumaceous?* (Chart. Specimens should be placed on the table, and the pupils should classify them.)

CLASS I. AGLUMACEOUS.

Point out and name the species of the IRIS family represented on the Chart. Tell their height, and color of their flowers. To what Linnæan class do most of them belong? Third. To what class does the Tiger-flower belong? Fifteenth. Why? Facts about the plants of the Iris family. (Fifth Reader, pages 186, 187.) Poetry. Repeat it or describe it, and tell who wrote it.

Species of LILY family represented on the Chart; height; color; Linnæan class (Sixth). Other plants that belong to the Lily family.† Facts (Fifth Reader, p. 187–8). Poetry.

* The cone or fruit of the pines is called a *strŏb'-ile.*

† Besides numerous species of the lily and tulip, the tuberose, garlic, onion, hyacinths, asphodel, Solomon's seal, asparagus, etc.

Species of the PALM family represented on the Chart; ordinary height. To what several Linnæan classes do they belong? Sixth, Nineteenth, and Twentieth. Facts concerning the Palms. (Fifth Reader, page 188–190.)

CLASS II. GLUMACEOUS.

[Specimens may be obtained at any season.]

What are included in the Glumaceous class? Sedges, Grasses, and Cereals. What are *cereals?* The cereals are the edible grains—such as Wheat, Rye, Barley, Oats, Maize, Rice, and Millet.

Point out and name the four species of SEDGE plants represented on the Chart, and tell their ordinary height.* What species of sedge are common in this country?† Facts about these plants. (Fifth Reader, pages 190, 191.)

GRASSES represented on the Chart; their height. Facts about the Sedges and Grasses. (Fifth Reader, p. 190, 191.) Poetry. To what Linnæan class do they belong? Third.‡

Point out and name the CEREALS represented on the Chart, and tell to what height they grow, etc. (Specimens should be exhibited, and the pupils should name them.) To what Linnæan class do the Cereals belong? Third. Facts about the Cereals. (Fifth Reader, page 192–194.) Poetry.§

* Specimens may be obtained at almost any season of the year. They may be readily distinguished from grasses by having the sheath at the base of the leaves *closed up*—not slit. See Fifth Reader, page 90.

† Yellow sedge, slender sedge, showy sedge, red-root sedge, horsetail rush, robin's clubrush (in water some of the stems are as fine as hairs), mountain rush, lake bulrush, sea bulrush, cotton grass, bogrush, white bog rush, whip grass, etc. More than two hundred species are common in this country.

‡ The teacher should inquire of pupils what grasses they are familiar with, etc.; and he should obtain statistics about the hay crop in the several states, and in his own county and town.

§ The teacher should be able to add numerous facts of his own gathering, such as the *kinds* of wheat, and of other grains cultivated in the country around—which are liked the best, and why; what summer fallowing is; times and modes of sowing and harvesting; implements used; quantity of grain per acre; prices per bushel; standard weight

THIRD DIVISION. CRYPTOGAMOUS PLANTS.

[Specimens of Ferns, Mosses, Lichens, and Fungi should be exhibited.]

What is the third great division of plants? Cryp-tŏg′-a-mous. See Chart, and Fifth Reader, page 196. What is meant by cryptogamous? Concealed fructification; having those parts, such as the pistils, stamens, etc., which produce the fruit, either *concealed*, or different from other plants. Into what two classes are the Cryptogamous plants divided? (Chart.) What are the leading peculiarities of each? (Fifth Reader, page 196.)

CLASS I. ACROGENS (AC′-RO-GENS).[1]

(Specimens of Ferns and Mosses on the table. It may be difficult for pupils to distinguish liverworts from mosses, but see Fifth Reader, page 198.) Point out and mention some of the Ferns, and tell their height; their general color. Some of the Liverworts. Some of the Mosses. Some facts concerning ferns. (Fifth Reader, page 196–198.) Concerning mosses. (Fifth Reader, page 199–201.) Poetry concerning ferns. Concerning mosses.

CLASS II. THALLOGENS (THAL′-LO-GENS).[2]

What are Thallogens? (Fifth Reader, page 196.) The three leading divisions of Thallogens? (Chart.)

Lichens.—(Specimens of Lichens and fungous plants can be obtained at any time, and in all parts of the country. Beautiful collections of lichens in great variety may be obtained from old wooden rails, rocks, etc., and by the aid of a little glue may be neatly arranged on thin pieces of

of a bushel; amount of flour per bushel; miller's *toll;* weight of barrel of flour; the process of bread-making; flour of different grains—what used for; statistics of amount of wheat and other grains produced in the county, state, and United States; amount and value of exports of each, etc., etc. See Census Reports, Agricultural Reports, and other means of information.

[1] From the Greek—*akros*, at the end, or top, and *gennao*, to produce, to grow. Hence, plants which grow from the end; summit growers.

[2] From the Greek—*thallos*, a young branch, and *gennao*, to produce.

board. We have seen them used for covering picture frames. Algæ, or Sea-weeds, may be obtained any where on the sea-coast.) Point out and name some of the Lichens represented on the Chart, and tell their height, etc. Facts concerning them. (Fifth Reader, page 202–205.) Poetry. If the teacher knows the names of any of the plants brought in, he should tell their names, and let the pupils label and preserve specimens. So of all other specimens of plants.

Fungous Plants.—What are *Fungi*, or fungous plants? (Fifth Reader, page 206.) Point out and name some of the species represented on the Chart, and tell their height, etc. Some facts concerning the Fungi. (Fifth Reader, pages 206–208.) Poetry.

Algæ, or Sea-weeds.—What are Algæ, or Sea-weeds? (Fifth Reader, page 209.) Point out, name, and tell the length of some of those represented on the Chart. Facts concerning the Algæ. Poetry, etc.

Compositions.—Not only each *class* in the three great divisions of plants, but each *family* also, will furnish abundant materials for a separate composition, even though the pupils may have taken only a general view of plants represented in each. After what has already been said as to the many particulars which may be mentioned in connection with plants, it would seem that no farther directions need be given.

CHART No. XXI. ECONOMICAL USES OF PLANTS.

The descriptions which are here given, of certain important portions of the Vegetable Kingdom, under the head of "Economical Uses of Plants," are designed to carry forward still farther the "object" system of instruction, in a *practical* continuation of the subject of Botany. It is designed that these descriptions shall aid the teacher in his familiar and instructive "object lesson" *talks* with the pu-

pils, upon the subjects of the several fruits mentioned. With this view, in connection with the questions, explanations, suggestions, and direct information imparted, the Linnæan class and order, and the leading divisions of the Natural Method also, are given, that the teacher may, if he think it desirable, have his pupils constantly reviewing the ground which they have already gone over, and repeating and verifying their observations upon the characteristic features of plants. Thus, in the case of the *apple*, which is put down as being in the eleventh class and fifth order of the Linnæan system, the teacher should require the pupil not only to *tell* the class and order, and *why* it is so, but also, if the flower be at hand, to *show* why it is so. So, likewise, as to its place in the natural system, the pupil should show why it is an exogen; why it is an angiosperm; and why it belongs to the natural order of Roseworts. These suggestions may answer for all the plants described. Other important plants or fruits not described here, the teacher may take up, and treat in a similar manner.

I. Our Common Fruits.

What fruits are represented in the First Division of this Chart? Name them.

1. The COMMON APPLE (*Py'rus ma'lus*, Lin. S., xi., 5; Nat. M., Ang. Exog., ord. *Roseworts**) is the most popular of all the fruits of the temperate zones. No other fruits can be brought to so high a degree of perfection with so little trouble; and of no other are there so many excellent

* The parenthetical description reads that the scientific name of the common apple is *Py'rus ma'lus;* that in the *Linnæan System* it is of the *eleventh class* and *fifth order;* and that in the *Natural Method* of classification it is an *Angiospermous exogens*, of the *order* of *Roseworts*. This parenthetical description is for the teacher's special benefit. The botanist Lindley has separated the apple, pear, quince, medlar, etc., from the Roseworts proper, and called them *Appleworts;* and he has also taken the almond, peach, nectarine, plum, cherry, etc., and classed them as an order of *Almondworts*. The term *wort*, which originally meant a *plant* or *herb*, is now used only in compounds. *Roseworts* are, therefore, merely *plants of the Rose order*.

varieties in general cultivation, adapted to almost every soil, situation, and climate.

Describe the APPLES represented on the Chart. Name as many parts of the apple as you can. The skin, the stem, the eye, the flesh, the core, the seeds. What do we mean by the *flavor* of an apple? Name and describe as many kinds of apples as you can.* Mention the various purposes for which apples are used. Ordinary prices per bushel, and barrel. Times of ripening and gathering. How winter apples should be gathered. Natural and grafted fruit, and how to obtain new kinds. (See Fourth Reader, page 213, and Fifth Reader, page 151.)

To which kind of flower clusters does the flower of the apple belong? The cor'-ymb—sometimes almost a complete

* In doing this, give size, form, and color; then describe the flesh and the flavor. The following descriptive terms, which we find in a work describing numerous varieties of the Apple, may be of some aid to the teacher. Many of them will also apply to other fruits.

FORM.—Round, roundish, conical, obtuse-conical, flattened, oblong, oblong-ovate, unequal-sided, angular. Skin warty, scabbed, tender, tough, thin, thick, wax-like, etc.

COLOR.—Red, dull red, lively red stripes, blotched with red, striped with red on the sunny side, crimson, blush cheek, blush, pink, russet, russet inclining to brown, golden russet, yellow, deep yellow, pale yellow, straw color, greenish-yellow, orange, green, yellowish-white, yellowish-green, greenish-white, etc.

FLESH.—White, yellowish, veined with red, pinkish near the surface, tender, crisp, firm, tough, juicy, dry, mellow, mealy, fine-grained, coarse-grained, melting, etc.

FLAVOR.—Acid, mild, mild acid, sprightly, sub-acid, sharp acid, tart, sour, rich, sweet, sugary, aromatic, spicy, rose flavor, rich vinous, etc.

Among the varieties in cultivation may be mentioned:

1. *Summer Apples.*—Early harvest, sweet bough, red Astrachan, summer rose, early strawberry, summer pippin, William's favorite.

2. *Fall Apples.*—Pearmain, Porter, Gravenstein, fameuse, mother, Jersey sweeting, maiden's blush, Hawley, fall pippin, Dyer, Vandervere, pound sweet.

3. *Winter Apples.*—Nonsuch, minister, Rhode Island greening, Baldwin, red Canada, Swaar, Northern spy, ladies' sweeting, Boston russet, Newtown pippin, Jonathan, rambo, seek-no-farther, Danvers sweet, Ortley, Hurlbut, Chandler, golden russet, Carle, wine apple, lady apple, Pryor's red, Wood's greening, Janet, winter blush, winter queen, nickejack.

um′-bel. Can you describe the form of the leaf of the apple? It is o′-vāte, a-cute′, or short a-cū′-min′-āte, ser′-rāte, and pet′-i-o-lāte. Give the reasons for each. Are both sides of the leaf alike? Examine. What is the color of the flowers? Usually a delicate pink. Of the fruit? Red, yellow, green, and russet, with all imaginable shades and interminglings of these colors.

2. The COMMON PEAR (*Py′rus commu′nis*, Lin. S., xi., 5; Nat. M., Ang. Exog., ord. *Roseworts*) is a fruit next in popularity and value to the apple. Among the numerous cultivated varieties may be mentioned the Bartlett, duchess, Madeline, Bloodgood, Dearborn, vergaloo, seckel, Julienne, Tyson, vanilla, Canandaigua, Stevens's Genesee, Dunmore, Flemish beauty, Maria Louisa, Dix, Onondaga, Beurré, winter bell and many others. Let pupils name and describe as many as they can.

How does the pear generally differ in shape from the apple? Name as many parts of the pear as you can. For what are pears used? Ordinary prices per bushel, or barrel. Describe the form of the *leaf* of the pear. It is o′-vāte-lan′-ce-o-lāte, partially ser′-rāte, and a-cute′. Are both sides of the leaf alike? It is smooth above, and downy beneath. Color of the flower? White. Of the fruit? Similar to the apple.

3. The COMMON QUINCE (*Py′rus cydo′nia*, or *Cydo′nia vulga′ris*, Lin. S., xi., 5; Nat. M., Ang. Exog., ord. *Roseworts*) is a rough-flavored astringent fruit, unfit for eating in the raw state, but admirable for stewing and making preserves. The two principal varieties are the apple-quince, and the pear-quince.

On what does the QUINCE grow? How does the quince generally differ in shape from the pear? Wider at the base than the pear; but, like the pear, its form is *ob*ovate. Can you describe the skin of the quince? It is yellow when ripe; and is clothed with a coat of short, entangled, and matted hairs, very different from the smooth skin of the apple. This kind of covering is called *tō-men-tōse′*. For what are quinces most used? For jellies and preserves.

What is the color of the flower of the quince? White, with a tinge of purple. What is the shape of the leaves? Ovate, acute, and *entire*. Observe that the margin is not toothed or serrate as in the apple and pear. Are both sides of the leaf alike? The leaf is smooth above, and downy beneath.

4. The PEACH (*Amyg'dalus per'sica* or *Per'sica vulga'ris*, Lin. S., xi., 1; Nat. M., Ang. Exog., ord. *Roseworts*) is the most exquisitely delicious of our common fruits—more gratifying to the palate by its mass of juicy pulp than the grape, and more delicate than the melon.

On what does the PEACH grow? On a tree, or shrub, from eight to fifteen feet high. How does the peach differ in shape from the fruits before described? It is more nearly round or *orbicular*. What is its size? From one to two inches in diameter. The two classes into which this fruit is divided? Freestones and Clingstones. Color and flavor of the fruit? The white peaches, the yellow, and the red-fleshed. The finer white-fleshed varieties are of a sugary flavor, the choice yellow-fleshed are of a vinous or wine flavor, and the red-fleshed are generally quite tart or acid. Describe the construction of the fruit, and tell wherein it differs from the apple. Like the apple, it is covered by a skin; but the skin itself, unlike that of the apple, has a downy covering; the flesh is more pulpy than that of the apple; instead of a *core*, the peach has a stone-like chamber, which contains the seed. The stone containing the seed is often called the *pit*. Purposes for which the peach is used. Describe the leaf. It is lan'-ce-o-lātȩ and serrate, from three to five inches long, one third as wide, smooth on both sides, and has short pĕt'-i-ōles. Color and odor of the flowers. Rose-color, with the odor of Prussic acid. Which appear first,\` the flowers' or the leaves\`? (For account of the *nectarine*, see Fifth Reader, page 152.) Let pupils tell the kinds of peach with which they are acquainted, time of ripening, etc.

5. The COMMON PLUM (*Pru'nus domes'tica*, Lin. S., xii., 1; Nat. M., Ang. Exog., ord. *Roseworts*) is a pleasant and

useful fruit, growing on a cultivated tree or shrub about fifteen feet in height. Among the numerous cultivated varieties may be mentioned the damson, Ottoman, peach-plum, Duane's purple, green gage, Bleecker's gage, Columbian gage, Orleans, scarlet, imperial gage, purple gage, long blue, golden-drop, late red, Ickworth, Jefferson, etc. About 150 varieties are published in the catalogues of American gardeners.

Describe the Plum. It is ovate in form; fleshy, like the fruits before described; smooth; varying in size and color; the *pit* is smooth, while that of the peach is deeply channeled. What uses are made of the plum? What are prunes? A species of dried plums, imported chiefly from Southern France, where this fruit is very abundant. Name and describe as many kinds of plums as you are acquainted with. Are their flowers all of the same color? Yes: white.

6. The Apricot (*Armenia'ca vulga'ris* or *Pru'nus Armenia'ca*, Lin. S., xi., 1; Nat. M., Ang. Exog., ord. *Roseworts*) is an early and pleasant fruit, blossoming immediately upon the opening of spring, but liable to be injured by early frosts.

What can you tell about the Apricot? The apricot is intermediate in size and character between the peach and the plum, having a skin, flesh, and pit, combining the characters of both. The tree is tender in this climate. It is usually budded on plum stocks, and trained against a wall with a southern exposure. It grows wild in Central and Southern Asia, and the mountains of the Caucasus are said to be covered with it. There are fifteen or twenty varieties cultivated. The fruit of the common apricot is a purplish yellow; the black apricot is of a dark purple color when ripe. Flowers white; leaves ovate, acuminate, some of them sub-cordate, smooth, and on long pĕt'-i-ōles.

7. The Grape (*Vi'tis*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Vineworts*) is said to be among fruits what wheat is among the cereal grasses, or the potato among farinaceous roots; and, like them, in every country where it will grow,

it is cultivated with pre-eminent care. Grapes are *berries*, which grow on woody vines in clusters, and on that kind of a ra-cēme′ called a *pan′-i-cle* (see page 188). The flowers are green; berry globular in form, purple, green, or red, and usually five-seeded; seed sub-cordate. Let the pupil name as many kinds of grapes as he can. Isabella, Catawba, red and white Muscat, black Hamburg, fox or frost grape, etc. What are plantations of vines called? (See, also, a lesson on grapes, Second Reader, page 29.)

For what are grapes used? Used chiefly as a dessert-fruit; also for drying, when they form the raisins and currants of commerce; and for making wine. The raisins are produced from various species of vines, and derive their name partly from the place where they grow, as Smyrnas, Valencias, etc., and partly from the species of grape of which they are made, as muscatels, blooms, sultanas, etc. The muscatels, from Malaga, are in the highest estimation. A small species of grape, largely cultivated in Greece and the Grecian islands, produces the dried currants of commerce, which are largely used in cakes and puddings.

What is *wine?* Wine proper is the fermented juice of the *grape* only, although we speak of currant-wine and other kinds of wine. The varieties of grape produced by cultivation are very numerous; and the *kinds* of wine depend not only on the kind of grape, but also upon the soil and climate. The well-known Isabella and Catawba grapes are natives of America. They have a purple color, and have as luscious a taste as the best grapes of Europe.

The principal kinds of wine are *Port* (from Oporto, Portugal, whence its name), which is of a dark purple or inky color; *Sherry*, from the vicinity of Cadiz, Spain—of a deep amber color; *Claret*, the red wines of the Gironde, in France; *Champagne*, so called from the province of Champagne, in France; *Burgundy*, mostly red wines, from the old province of Burgundy; *Madeira*, so called from the island of that name; *Malmsey*, a Madeira wine, made from grapes grown on rocky grounds exposed to the full influence of the sun's rays; *Teneriffe*, so called from the island

of that name; and *Tokay*, so called from a town of that name in Hungary—said to be the finest of all the wines. There are also *German* wines, the *Sicilian* white wines, *American* wines, etc. Most of the American wine is of the kind called white wine.

Brandy is mixed with nearly all foreign imported wines, and especially with the Port wine shipped from Oporto; and, indeed, so extensive and so varied are the adulterations that pure unmixed wine of any sort is exceedingly rare. The best wines are also extensively imitated, and sometimes without containing any of the juice of the grape. It is said that more of the so-called "*Tokay*" wine is sold annually in New York city alone than is produced from all the vines of Tokay. The acid of grapes is chiefly the tartaric. The sugar contained in grapes differs slightly from common sugar in composition, containing a smaller quantity of carbon.

8. CURRANT.—The common RED CURRANT (*Ri'bes ru'brum*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Currant-worts*), is a one-celled berry, filled with pulp, in which are contained numerous seeds. The currant-*stem* is a good example of the ra-cēme'. The *leaves* are from three to five-lobed, smooth above, slightly downy beneath, mucronately serrate,* and sub-cordate at the base.

9. The FILBERT (*Cor'ylus avella'na*, Lin. S., xix., 12; Nat. M., Ang. Exog., ord. *Mastworts*) is the well-known fruit of the cultivated European hazel-nut. It belongs to that order of plants called *mastworts*, which includes the oak, the beech, and the Spanish chestnut. It grows on a shrub

* Leaves of the red currant should be laid before the pupil, who should be led to notice all these little particulars in their forms, and then, if possible, find terms descriptive of them—either terms of his own, or such as we have above given. He has already learned what a *serrate* leaf is, and that when the leaf is tipped with a little point it is said to be *mŭ'-cro-nāte*. But here the *serratures* themselves are slightly mucronate. It may be thought that this is a small particular; but the child who can be led to notice it of his own accord, and to find a term descriptive of this peculiarity, will have already entered upon that course of close observation which characterizes the scientific discoverer.

from two to ten feet in height. Observe the resemblance between this nut and the acorns and beech-nuts. The three well-known varieties of the filbert are the red, the frizzled, and the white. The latter is the kind most commonly cultivated. The husk which incloses the nut of the filbert is the că′-lyx of the flower. It will be seen, from the engraving, that it is *cam-pan′-u-late*, or bell-form, spreading at the apex, and torn-toothed.

The American hazel-nuts, like the wild hazel-nuts of Britain, grow on small shrubs from two to five feet high, found in thickets and borders of fields. They are excellent, but are inferior to the cultivated European nut. They might, perhaps, become equal to it by long-continued cultivation.

(Let children bring in specimens of acorns, beech-nuts, and common hazel-nuts, to describe, and compare with the filbert. The latter, also, which may be had at almost any country store, should be obtained.)

10. The English or Garden GOOSEBERRY (*Ri′-bes grossula′ria*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Currantworts*) is a well-known, cultivated, globe-like (globose) fruit, of a lively but pleasant acid taste, and belonging to the same family as the currant. The branches are prickly; some kinds have smooth berries, others hairy; leaves roundish, from three to five-lobed, hairy beneath, and on hairy pĕt′-i-ōles. Observe that the little green că′-lyx which incloses the flower of the currant and gooseberry is bell-form and five-cleft, and that the cŏr′-ol and stā′-mens are inserted on the că′-lyx. These are not too small particulars for children to notice. There are now several hundred varieties of the gooseberry produced by cultivation, with red, white, green, and amber fruit. Gooseberries are sometimes raised of monstrous size for exhibition, by leaving on the bush only a few berries, and supporting them so that they do not hang by their stems, but rest and fatten. In our climate the gooseberry is very subject to mould or mildew. Ask the children if they know what *mould* is. Describe it. (See Fourth Reader, page 172, verse 3; and Fifth Reader, page 206, Fig. 11, and verses 1 and 2.)

11. The GARDEN RASPBERRY (*Ru'bus idæ'us*, Lin. S., xi., 13; Nat. M., Ang. Exog., ord. *Roseworts*) is a well-known native berry, growing wild in all parts of the country, but greatly improved by cultivation. It is of a somewhat acid taste, but, like the strawberry, it is one of the few fruits that does not undergo the acetous fermentation in the stomach. There are numerous varieties. (Pupils should name and describe as many as they can.) Besides the common black and red varieties that are found growing wild, there are the red and yellow Antwerps, Franconia, Fastolff, etc.

The berry is composed of numerous pulpy one-seeded grains (called *ac'-i-nes* or *ac'-i-ni* by botanists), situated on a dry receptacle. Pupils should be led to examine these pulpy grains, and to take them off carefully to see how they are arranged on the receptacle. Let them notice, also, that the little green cup (că'-lyx) inclosing the flower is five-cleft, and that the flower is five-pĕt'-aled.

12. The HIGH BLACKBERRY (*Ru'bus villo'sus*, Lin. S., xi., 13; Nat. M., Ang. Exog., ord. *Roseworts*), which is a thorny shrub, growing wild, from 4 to 6 feet high, in all parts of the country, is beginning to be cultivated as a garden fruit. Of the cultivated varieties, the "New Rochelle" and "Lawton" have thus far been the most popular. Let pupils bring in portions of stem, leaves, and fruit, and describe them. It will be found that the blackberry has an *angular* stem; leaflets from 3 to 5, ovate, acuminate, serrate, hairy on both sides. The pet'-i-oles are prickly; petals white. Calyx and flower similar to those of the raspberry. The fruit, which ripens in August and September, is collected into an ovate or oblong head. Let pupils examine and tell wherein it differs from the raspberry.

13. The ENGLISH STRAWBERRY (*Fraga'ria ves'ca*, Lin. S., xi., 13; Nat. M., Ang. Exog., ord. *Roseworts*) excels all other fruit-bearing herbaceous plants in the excellence of its fruit. It grows wild in great abundance in many parts of the country; but the cultivated varieties are much the largest and best flavored. The fruit is sometimes an ounce or more

in weight. The strawberry has five petals, but the stamens and pistils are very irregular. It frequently happens that the strawberry is deficient either in stamens or pistils; and when this is the case, if those of one kind only are planted together, they will not bear fruit. The runners which take root, and send up independent plants, are called *stolons* by botanists. The leaves are in threes, downy; flowers white; berry similar to the blackberry in shape.

Let the pupils name the varieties with which they are acquainted, and describe them as to color, size, shape, weight, etc., as well as they can. Among the prominent varieties the large early scarlet, Longworth's prolific, Wilson's Albany, Genesee, Walker's seedling, Jenny Lind, and some others, have perfect flowers, and bear fruit when planted alone. Hovey's seedling, crimson cone, Burr's new pine, M'Avoy's superior, Monroe scarlet, Moyamensing pine, Jenny's seedling, and some others have imperfect flowers, and are comparatively unfruitful unless planted with varieties that have either perfect or *staminate* flowers.

Other common fruits and vegetables, not represented on the Chart, but which may be mentioned in this connection, and described by the pupils, are cherries, cranberries, pumpkins, squashes, cucumbers, water-melons, muskmelons, egg-plants, tomatoes, peas, beans, salsify or vegetable oyster, mushrooms, etc. Some of the pupils will doubtless be able to describe several kinds of many of these.

Among nuts, the hickory-nut or walnut, black walnut, butternut, chestnut, etc. Among garden edibles not mentioned are artichoke, asparagus, kale, cabbage, cauliflower, leek, celery, cives or chives, garlic, pepper-grass, lettuce, cress, spinach, parsley, mustard, horse-radish, mint, thyme, sage, marjoram, balm, nasturtion, etc.

The pupils may easily make collections of the seeds of these, of those represented on the Chart as "Our Common Fruits," and already described, and also of many other plants of value, including the "Common Root Plants;" and in this manner, and by a system of exchanges with

each other, they may form private cabinets of seeds, and also a handsome and valuable cabinet for the school-room.

Pupils should learn to distinguish these seeds, and to name them at sight; and they should know the proper times and modes of sowing them, their proper cultivation, the dangers to which they are liable from insects, worms, blight, drouth, etc.; and they should describe the various uses of the plants themselves. What a field for investigation, and for early education upon the *Development* or "Object" system, is here opened! Early cultivation of the perceptive faculties, which gives the best of mental discipline, and the acquisition of useful knowledge, may here be harmoniously combined.

CABINETS OF SEEDS for the school-room, which are designed to aid in carrying out the principles of instruction herein developed, are now in course of preparation.* They are designed to embrace not only the seeds of most of the plants represented on Charts XXI. and XXII., but also a considerable variety of others that are of value in cultivation—such as different kinds of corn and grain plants, grasses, and fruits from temperate and tropical climates. It is supposed that one such collection in one school of a town or neighborhood, will not only greatly aid in carrying out the admirable system of instruction by lessons on *objects*, but that it will be the means of awakening a great degree of interest in the subjects of agriculture, horticulture, gardening, etc. Pupils will be able to greatly enlarge such a collection from their own resources, and neighboring schools will be incited to get up collections of their own.

II. Common Root Plants.

The RADISH (*Ra'phanus sati'vus*, Lin., xiv., 2; Nat. M., Ang. Exog., ord. *Crucifers*), which belongs to the large order of plants having cruciform or cross-shaped flowers, is a well known salad root, originally from China. There are two principal varieties of this root—the one spindle-shaped,

* July, 1862. At the office of the "American Educational Bureau," New York City.

and the other turnip-shaped or globular, as represented on the Chart. There are also sub-varieties arranged as spring, summer, autumn, and winter radishes. All are of easy culture and rapid growth. The most common radishes have roots of a purple color; there are also white, scarlet, rose-colored, and black radishes. (Let pupils tell the kinds with which they are acquainted; color and size of seed; time of sowing; soil best adapted to them; how long after sowing before the roots are fit for eating; how they are eaten, etc.) The stem of the radish grows from two to four feet high; is very branching, bearing white flowers, or tinged with purple, succeeded by long, thick, fleshy, two to three-sided, acuminate pods, which contain the seed. (Pupils should examine the construction of these pods when ripe, and notice how they open, etc., and how they differ, in this respect, from many other pods. Let them notice the shape of the lower leaves, which are *pinnately cleft*. See Chart No. XIX. They are also called *lyrate* leaves, or lyre-shaped, because they have the end lobe largest and rounded.)

The SWEET POTATO (*Convol'vulus bata'ta*, or *Bata'ta ed'ulis*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Bindweeds*), which is extensively cultivated for its root in tropical climates, and in the United States as far north as New Jersey, is an herbaceous, perennial plant, which sends out round, pale-green, trailing stalks, extending six or eight feet every way. In a genial climate these put forth at their joints roots which grow to be very large tubers, so that from a single plant forty or fifty large potatoes may be produced. The leaves are angular, cordate at the base, and on long pet′-i-oles. Flowers showy, rose-purple, and campanulate or bell-shaped, similar to those of the morning-glory; potato brownish yellow.

The COMMON POTATO (*Sola'num tubero'sum*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Nightshades**) is a biennial

* This order of *Nightshades* includes not only the wholesome potato and tomato, but also some virulent poisons used in medicine, such as the deadly nightshade or belladonna, henbane, stramonium or thorn-apple,

herbaceous plant, a native of South America, where it still grows wild in the elevated regions of the tropics. It is believed to have been first introduced into England in the year 1586. The sweet potato was known in England before that period. What is eaten as the "potato" is not the *root* of the plant, but the *tubers* of its subterranean stem. The flowers are white, or of a purple tinge; corolla five-cleft, and somewhat bell-shaped; the stem or stalk is what is called wing-angled. The *fruit*, containing the *seeds*, is the well-known "*potato ball*" that grows on the stalks. New varieties are often obtained by planting the seeds. When the potato itself is planted, it sprouts from what are called the *eyes*, each of which contains the germ of a future plant.

The potato is a very economical article of food; and it has been estimated that an acre planted with potatoes will produce more than double the quantity of nutriment than when sown to wheat. Two hundred bushels of potatoes to the acre, at sixty pounds weight to the bushel, is only a moderate average. Some of the varieties cultivated are the Mercers, Mashanocks, pink-eyes, Carters, kidneys, blue-noses, Western reds, early Junes, etc. (Let pupils tell the kinds they are acquainted with, time of planting, of gathering, prices per bushel, etc.)

The COMMON ONION (*Al'lium ce'pa*, Lin. S., v., 1; Nat. M., Agl. Endog.,* ord. *Lilyworts*) is strongly-scented, bulbous, biennial plant, universally cultivated in gardens. It is usually raised from the seed, which, sown early in the sea-

and tobacco. An extract from the leaves of the common potato is a powerful narcotic. It is only the *tubers* of the potato that are wholesome when cooked. The genus capsicum, whose ground seeds are known as Cayenne pepper, also belongs to this order. Quantities of the common potato, in a state of putrefaction in a dark place, have been known to give out a most vivid light, sufficient to read by.

* The plants previously described on this Chart belonged to the great division EXOGENS; but this is an ENDOGENS, or an ENDOGENOUS plant. See Fourth Reader, page 176, and Fifth Reader, pages 144 and 186. It also belongs to the *Aglumaceous* class of the Endogens—for which see Def. page 190, Fifth Reader.

son, produces the bulb fit for eating in the summer and fall. If the bulb be planted in the succeeding spring, it sends up a straight, smooth, stout, hollow stalk, from three to four feet high, bearing at top a large round umbel of greenish-white flowers. The large, old, and refuse onions are called scallions. The leaves, which are radical—that is, growing from the root—are *fistular*, like the stem: that is, *hollow*, or tubulous. Of the common Black-seed Onions, the red, white, and yellow are the principal varieties.

There are, also, the red, white, and yellow Top Onions, which produce small onions, as the common kinds yield their seed, in a ball at the top of the stalk. Still another kind, the Potato or Hill Onion, produces a number of bulbs in a hill just below the surface of the ground. There is also the Welsh Onion, which resembles a large scallion, and is used only while green.

It is said that those onions which have a tinge of red or purple are more pungent than those which are white; and that those which have the rind, or outer membranous covering of the bulb, thin and transparent, are always of milder flavor than those which have it thick.

The Common Turnip (*Bras'sica ra'pa*, Lin. S., xiv., 2; Nat. M., Ang. Exog., ord. *Crucifers*), which has long been cultivated in gardens and in fields, both for the table and for cattle, is a biennial plant, most of the kinds having a depressed (somewhat flattened) globose root, contracted below into a slender radicle. In the second season after sowing a flowering stem shoots up, from two to four feet high, bearing yellow flowers, and having the four petals arranged in the form of a cross, and therefore called *cruciform*. The radical or root leaves are rough, deep green, and lyrate in form, like those of the radish; the cauline or stem leaves are cut or jagged, and the upper leaves are entire.

There are numerous varieties of the common turnip, varying in color and shape, among which are the early red-top or purple-top, early Dutch, early stone, long or tankard, yellow Aberdeen, yellow globe, etc. (Let pupils name and

describe the kinds with which they are acquainted.) The hardy Swedish turnip, or ruta baga, which sometimes grows to an enormous size, and is cultivated chiefly as food for cattle, has a yellowish root.

The turnip furnishes a surprising example of rapid growth. A seed of the common turnip has been estimated to weigh the fourteen thousandth part of an ounce; and, assuming its growth to be always uniform, it has been calculated that a turnip-seed may increase fifteen times its own weight in a minute. By actual experiment made on very rich soil, turnips have been found to increase by growth 16,000 times the weight of their seeds each day they stand upon it. The average of a turnip crop, whether ruta baga or the common turnip, is estimated at ten tons to the acre.

The Common Parsnip (*Pastina'ca sati'va*, Lin. S., v., 2; Nat. M., Ang. Exog., ord. *Umbelliferous Plants*) is a biennial, with a sweet-flavored, fusiform or spindle-shaped root, usually larger than the carrot. In the second season it sends up a smooth, erect, furrowed, and branching stem, about three feet high, producing small yellow flowers on a large umbel. The leaves are pinnate, downy beneath, and smooth above. There are several varieties, such as the Guernsey, round, yellow Siam, and long white—the latter sometimes running three or four feet into the ground in a sandy soil.

The parsnip grows wild abundantly in fields, by fences, etc., where its root is small, hard, bitter, and poisonous. When the parsnip grows upon well-tilled *poor* land it is more sweet and agreeable than when raised in richer soils. As it is but little injured by being frozen, it may remain in the ground through the winter. The average yield is ten tons per acre. (Let the pupil describe the kind of parsnip with which he is acquainted—its color, size of root, shape, manner in which it is cooked, etc.)

The Carrot (*Dau'cus caro'ta*, Lin. S., v., 2; Nat. M., Ang. Exog., ord. *Umbelliferous Plants*) is also a biennial, having a fusiform or spindle-shaped root. In the second season it

sends up a branching stem from two to three feet high, bearing small white flowers, nearly all summer, in a terminal umbel. The leaves are pale green, very numerous, pinnate, having the divisions or leaflets narrow, linear, and acute. The seeds are oblong, hispid or bristly, and contained in a roundish pod having bristly ribs. It is said that the seeds do not retain their vegetative powers more than a year. Of the cultivated carrot there are many varieties—such as the early horn, long orange, Altringham, long purple or blood, long white, etc. The early horn and long orange are the only kinds desirable for garden culture. Average produce per acre, ten tons. Let the pupil tell for what purposes the carrot is used—boiled, fried, in soups, etc., and as food for cattle. Eight hundred bushels of carrots per acre have been obtained. For sowing the seed, which is very light, it is best to mix them thoroughly with fine sand, in the proportion of four or five pounds to the bushel of sand; let the whole lie in heaps, and occasionally water for two weeks before sowing. A light, but rich, and deep, and mellow soil, mixed with sand, is the best for all long-root plants; for if the ground is hard, the roots will grow forked, and shoot out lateral branches.

The COMMON BEET (*Be'ta vulga'ris*, Lin. S., v., 2; Nat. M., Ang. Exog., ord. *Chenopods** or *Goosefoots*) is a biennial cultivated root, having the form of the carrot, but thicker in proportion to its length. The root is most commonly of a red color, very juicy, and when wounded bleeds freely. The leaves are large, long, acute, and smooth, green or purplish, and having a long pet'-i-ole; flowers greenish-white, sessile or seated, heaped together, and arranged on slender spikes. The beet root is much used as a pickle, and the tender leaves are boiled and eaten as greens. The root is sometimes preserved as a confiture or sweetmeat; and some dry and grind the root, and make it a substitute for coffee. The juice also makes a good varnish.

* From the Greek *chēn*, a goose, and *pous*, a foot, from the similarity of the leaves to the webbed feet of a water-fowl.

By long culture this valuable root has run into many varieties, among which are the *early blood turnip-beet*, with a short and thick root like that of the turnip; the *long blood-beet*, the best for winter use; the *white sugar-beet*, or *early white scarcity;* the *mangel-wurtzel* or *red scarcity*, which is a red-skinned beet, but white inside, growing much out of the ground; and the *yellow sugar-beet.* "If the long beets are raised for a series of years in ground not deeply plowed and well pulverized, and the seed sown from them is annually resown, they will become shortened in growth, or form a habit of growing much above ground, and thereby deteriorate in quality for the table."

The white sugar-beet is largely cultivated in France, Belgium, Germany, and Russia for the sugar obtained from it. The best beets yield from six to eight per cent. of pure sugar. France annually produces about 60,000 tons of beet sugar, about half the quantity that is used in the kingdom. The average yield of beets is estimated at from ten to fifteen tons per acre. In Germany, 100 tons of the mangel-wurtzel have been raised on an acre.

III. The Cereals, or Corn Plants.

The grain-bearing or corn plants are called *cereals*, from Ceres, whom the ancients regarded as the goddess of corn and harvests. (See Fifth Reader, page 194.) That one among the cereals upon which any people depends chiefly for its food is called by that people *corn*—as *wheat* in England, *oats* in the northern Lowlands of Scotland, *rye* in the sandy districts on the southern shores of the Baltic Sea, and *maize* or *Indian corn* in some parts of the United States.

COMMON WHEAT (*Trit'icum vulga're*, Lin. S., iii., 2; Nat. M., Glu. Endog., ord. *Grasses*) is both an annual and a biennial, having the culm (the name given to the straw of grasses) terēte or round, and smooth, from three to five feet high, bearing at the top the *head* of wheat, which belongs to the kind of flower-stem called a *spike.* (See Chart No. XIX.) The spike is somewhat four-sided, and is crowded

with spikelets (little spikes), which are usually about four or five flowered, and which contain the *grains* or *kernels* of wheat, although not often more than two perfect kernels are contained in a spikelet. Notice the *glumes*, *husks*, or *chaff*, which inclose the grains. The pupil will see, by examining a head of wheat, that at the base of each *spikelet* are two of these husks or chaff-leaves. These are called, in botany, *glumes*. The inclosing husks or chaff of each separate kernel are called *pal'eæ* (singular, *pal'ea*). Let the pupils examine heads of wheat until they can readily distinguish the *glumes* from the pal'eæ. This can be done at any season of the year. It will be a good *object* lesson. Pupils may then extend their observation to any of the grasses which they can obtain. They will find that all of them have *glumes*. Hence all the grasses, among which the cereals are included, are said to be *glumaceous*. The cereals and grasses have stamens and pistils, but no corolla. The straw or *culm* of the wheat bears leaves, which are long and lance-linear, veined, and roughish above. There are several varieties of wheat.

1. Summer wheat (*Trit'icum æsti'vum*), which is sown early in spring, and harvested the same season, is less hardy than winter wheat; the whole plant has a weaker appearance; the ear is more slender; and its glumes or husks are usually provided with much longer beards or awns.

2. Winter wheat (*Trit'icum hyber'num*), the kind represented on the Chart, is sown in autumn; it lives through the winter, and ripens its seed in the following summer. There are several varieties of this—such as the red chaff, the white chaff, awned, beardless, etc. Probably more than fifty kinds, many of them, however, differing but little from each other, are known in the United States.*

* The chief varieties of wheat cultivated in the Northern and Eastern states are the white flint-wheat, tea-wheat, Siberian, bald, Black Sea, and the Italian spring wheat; in the Middle and Western states, the Mediterranean wheat, Virginia white May, the blue stem, the Indiana, the Kentucky white-bearded, the old red chaff, and the Talavera. The yield is from ten to forty bushels and upward per acre. In the year

(Let the pupils name and describe as many kinds as they are acquainted with—telling the time of sowing; how much wheat is sown to the acre; mode of preparing the ground; what summer fallowing is; time and modes of harvesting; ordinary quantity per acre; modes of threshing; standard weight of wheat per bushel (60 lbs.); the grinding of wheat; how millers are usually paid for grinding; what is meant by miller's toll, and how much it is per bushel; how much flour is usually obtained per bushel, and what the other parts obtained from grinding are called, and what they are used for; how many bushels of wheat are estimated to make a barrel of flour; legal weight of the flour in a barrel; present prices of wheat per bushel, and of flour per barrel; describe the process of bread-making, etc.)

3. The Egyptian or many-spiked wheat (*Trit'icum compos'itum*), also called the "Corn of Abundance," is principally cultivated in Egypt and Italy. It resembles spring wheat in its habits; its grains are thinner than those of winter wheat, and it will bear great degrees of drouth without injury. Its spike is compound at the base, and the spikelets are three-flowered.

There is also a kind of wheat called *spelt* wheat, grown in elevated situations in Switzerland and Germany, where common wheat will not ripen; but the grain is light, yields but little flour, and makes but indifferent bread.

Wheat *starch* is made from wheat. In some countries the wheat straw is manufactured largely into hats—the best straw being obtained from chalky lands. Leghorn hats are made from the straw of a bearded variety of wheat, which grows only about eighteen inches high, on poor sandy soils on the banks of the Arno, near Leghorn, in Italy. It is pulled green, and bleached like flax.

COMMON RYE (*Seca'le cere'ale*, Lin. S., iii., 2; Nat. M.,

1840 the wheat crop of the United States amounted to 84,823,272 bushels; in 1849 it amounted to 100,503,899 bushels; in 1857 it was estimated at 200,000,000 of bushels. During the year 1840 the average price of flour in New York city was $5 17 per barrel; in 1849 it was $4 96; in 1855 it was $9 06.

Glu. End., ord. *Grasses*) is both an annual and biennial, from four to six feet high, bearing its grains in a *spike* at the top of the culm or stem. The *spikelets* (little spikes) are from two to three-flowered, and each usually produces two seeds, or grains. (In wheat they are usually four-flowered.) The lower *pal'eæ* have long awns, or beards. Let the pupil distinguish the *pal'eæ* from the *glumes*, as described under the head of wheat. The culm or stem is hairy beneath the spike; leaves lance-linear, having a rough edge, and rough above. (It will be a good exercise for the pupil to compare the rye and the wheat, and see if one is, in any respect, different from the other.)

Although rye will ripen if sown in spring, it does better when treated like winter wheat. Rye flour was formerly much used for making bread, but has now mostly given place, in this country and Western Europe, to wheat. In Central and Northern Europe it is still much used, and especially in the sandy districts south of the Baltic Sea and the Gulf of Finland.

Rye is liable to a disease, which produces in the head the growth of a brownish, smutty, and poisonous substance called *ergot*. Terrible epidemic diseases have been occasioned in Europe by the use of such diseased rye.

(Let the pupils give an account of rye—the sowing, grinding, the flour, etc., similar to the directions given about wheat.)

BARLEY is a species of bread corn, of which there are several varieties. Common Spring Barley (*Hor'deum vulga're*, Lin. S., iii., 2; Nat. M., Glu. End., ord. *Grasses*) is a four-rowed barley, and the kind most commonly cultivated. It grows from two to three feet high. The leaves are lance-linear, nearly smooth. Observe that where they join the stem they are furnished with a sharp ridge or projection on the under side. This is called *car'inate* or boat-shaped, or *keeled*. The *spike* is about three inches long, and is heavily awned or bearded, both in the *glumes* and the *paleæ*. Let the pupils compare barley, in this particular, with wheat and rye.

Winter Barley, a six-rowed barley, a more hardy species than spring barley, has also a shorter and thicker spike, and a larger grain.

There is also a long-eared or two-rowed barley, which is beardless. Other species are described by botanists.

Barley flour was once thought to make excellent bread. The Romans cultivated it for their horses, and also for the army. The Roman gladiators were called *Hordiarii*, from their feeding on this grain. A large proportion of the population of Wales, and of some counties of western England, still subsists chiefly on barley bread.

Barley is now, however, chiefly cultivated to be made into *malt*, which is used in brewing ale, porter, and beer. For this purpose the grain is steeped in water, and fermented in heaps until it begins to germinate, when the germination is arrested by sudden drying, called kiln-drying. In this process of malting a part of the mucilage or starch of the grain is converted into sugar, so that the total quantity of sugar, the source of spirit, is increased. The produce of barley varies, according to the soil, preparation, season, etc., from twenty to sixty or seventy bushels to the acre. It is a tender plant, and easily hurt in any stage of its growth. A little more than seven millions of bushels were raised in the United States in the year 1850.

Buckwheat (*Polyg'onum fagopyr'um*, or *Fagopyr'um esculen'tum*, Lin. S., viii., 3; Nat. M., Ang. Exog., ord. *Buckwheat**), though not belonging, botanically, to the Cereals, is used as a bread fruit, and may therefore be described here. The Germans call it *Beech-wheat*, from the resemblance which the grains bear in shape to the nuts of the beech-tree. Specimens of this plant should be obtained and examined by the pupils. Let them describe it. It is an annual herb. Calyx five-parted, and withering, of a pink color. This plant has, properly, no *petals* or flower leaves; but what appears to be the corolla is a colored calyx. Stamens, 8; styles, 3. Leaves *cordate* or heart-shaped, some

* In this same order are found the sorrels, rhubarb, docks, persicarias, etc., and the sea-side grapes of the West Indies.

of them tending to *hastate* or spear-shape. Stem from two to four feet high, branching, green, with a reddish tinge. Fruit or seed triangular, brownish-black on the outside, and white within. This plant is not only cultivated, but it grows wild also in old fields. The flowers are much sought after by bees; but buckwheat-honey is of a dark color, and has a rank taste.

Buckwheat is usually sown in June; and it grows so rapidly that it generally ripens its seeds within about one hundred days from the time of sowing. It will grow in any soil, even where there is little else than sand; but it thrives best in dry ground which has been thoroughly plowed and pulverized. From thirty to forty bushels per acre may be considered a good yield; but sixty or more bushels to the acre have been obtained, and from only one bushel of seed. About nine millions of bushels were raised in the United States in the year 1850. The grain is excellent for feeding pigeons and poultry, and in the form of "buckwheat cakes" it is a delicious article of food for the human race.

Rice (*Ory'za sati'va*, Lin. S., vi., 2; Nat. M., Glu. End., ord. *Grasses*), one of the most important of the Cereals, is supposed to have been originally brought from Southern Asia, where it is still almost the universal food of the inhabitants. It is more extensively consumed than any other grain. Rice is mostly an annual plant; culm or stalk from two to five feet high, erect, simple, round, and jointed; leaves long, rough, and lance-linear; fruit in a terminating *panicle*. Each grain is terminated with an awn or beard, as shown in the cut, and inclosed in a rough yellow husk. The stalk is quite similar to that of wheat, but the joints are more numerous. The whole plant, before ripening, bears a near resemblance to barley. Before the rice is cleared of the husk it is called *paddy*. The rice of commerce has been parboiled in caldrons, partly to destroy the vegetative principle, so that it may keep better, and partly to facilitate the process of removing the husks.

There are several varieties of this grain. *Common rice*

is a marsh plant. If the ground on which it is sown should become dry before the plants arrive at maturity they wither. The best rice produced in the world is believed to be that grown on the salt-marsh lands of South Carolina and Georgia. It ripens in about six months from the time of sowing. The yield per acre varies from 20 to 60 bushels, each bushel weighing from 45 to 48 pounds when cleaned. Hence it is lighter than wheat.

There is a variety called *early rice*, which ripens in about four months. *Mountain rice*, sown on mountain lands and other dry soils, may be treated as a biennial, and sown in autumn. The grain is longer than in other varieties, and has longer awns; but the produce is only about 20 bushels to the acre. What is called *clammy rice* grows both on wet and on dry lands.

In Carolina rice-seed is sown early in March, in rows, in the bottom of trenches which are about 18 inches apart, and carefully covered by hand. After this the water, which has been kept back by the floodgates, is let in, and for about a week is allowed to cover the ground several inches. It is then drawn off; but when the plants, which shoot up rapidly, are about four inches high, the fields are again overflowed, and remain in this condition some two months. After this they are hoed repeatedly, and are overflowed for the third time about the middle of July, the water now remaining until the grain is actually ripened. This alternate flooding and drying of the land in so hot a climate, renders the cultivation of rice exceedingly unhealthy to the negroes who perform the labor. The rice harvest usually commences at the end of August, and extends through the month of September. The male negroes cut the rice with a sickle; the females follow and collect it into bundles. When ripe the rice stalks turn yellow, the same as those of wheat. The threshing is usually performed with flails. The cultivators of rice in the United States sometimes suffer severely from the depredations of immense flocks of the *rice-birds*, commonly called bobolink in the Northern States, and the reed-bird in Delaware. This

bird is about six or seven inches long; the head and under parts of its body are black; the upper parts are a mixture of black, white, and yellow; and the legs are red. Irving has written a beautiful sketch of its habits, which we had not room for in the Fourth Reader.

It is said that the average yield of rice in the rich meadow lands of Lombardy, Italy, is one hundred bushels to the acre, from three bushels of seed. In the year 1850, two hundred and fifteen millions of pounds of rice were produced in the United States.

MILLET.—Of the grains cultivated under this name there are several distinct kinds, belonging to different families of plants, but all are annuals. The first that is represented on the Chart is commonly known as *panicled* millet (*Pan'icum milia'ceum*, Lin. S., iii., 2; Nat. M., Glu. End., ord. *Grasses*). Of this kind there are two varieties, the brown and the yellow. This kind of millet grows from two to three feet high, producing its seeds on a large, open, and nodding *panicle*, as represented on the Chart. It is now raised chiefly for feeding poultry, but was formerly much used in the place of rice. The seeds or grains are the smallest of the cereals, but an immense number is borne on each stalk.

Indian Millet (*Sor'ghum vulga're*, Lin. S., iii., 2, etc.), also sometimes called Grand Millet, and Sorghum, and in the West Indies Negro Guinea Corn, grows from five to eight feet high, with an erect culm or stalk, round, solid with pith, leaves *carinate* or keel-shaped, like those of barley, and lanceolate. The panicle is erect until the seeds are ripe. Its long awns, or bristles, effectually defend it from the birds. In India the sorghum is still largely cultivated, and in Arabia and Syria it forms a large part of the food of the inhabitants. The flour of this cereal is white, and good bread and cakes are made of it. Brooms are made of the spikes. *Broom-corn* is a species of sorghum. Its uses are well known. The *Chinese sugar-cane* is also supposed to be a variety of the sorghum or Indian millet.

Italian or *German Millet* (*Seta'ria Ital'ica*, or *German'-*

ica), also represented on the Chart, is cultivated in some parts of Europe. The Italians make from the flour a kind of bread which is dark-colored and coarse.

The COMMON OAT (*Ave'na sati'va*, Lin. S., iii., 2; Nat. M., Glu. End., ord. *Grasses*) is an annual, growing from two to four feet high, with leaves linear-lanceolate, veined, rough; the culm or stalk having an open panicle, with pendulous spikelets. The grain of the oat, although used chiefly as food for horses, is also used as a bread corn in some countries, and especially in Scotland and the northern parts of England. Twenty-eight pounds of grain yield about sixteen pounds of meal. Oat-meal gruel is an excellent article of diet for the sick.

There are many varieties of the oat in cultivation, such as the common beardless oats; white, black, gray, and brown or red oats; the Egyptian, Polish, imperial, and potato oats, etc. What is called the animal oat (*Ave'na ster'ilis*) is sometimes cultivated as an object of curiosity. After the seeds have fallen off the strong beard is so sensitive to changes in the atmosphere as to be kept in apparently spontaneous motion, when they resemble some grotesque insect crawling on the ground.

The oat is the hardiest of the cereals, and is suited to climates too hot or too cold for either wheat or rye, although it thrives best in northern latitudes. In this country its growth is confined principally to the Middle, Western, and Northern States. The yield of the common varieties varies from 40 to 90 bushels and upward to the acre; and the different varieties vary in weight from 25 to 50 pounds to the bushel. The total produce of oats in the United States in the year 1850 was but little less than one hundred and fifty millions of bushels. Prices vary from 25 to 60 cents per bushel.

Let the pupils bring in samples of stalks and grain—tell the kinds with which they are acquainted; times and modes of sowing, and harvesting; prices, uses, etc.

MAIZE, or INDIAN CORN (*Ze'a mays*, Lin. S., xix., 3; Nat. M., Glu. End., ord. *Grasses*) is an annual, having a strong,

erect, reedy, smooth, jointed stalk, grooved on one side, growing from five to fifteen feet high, and provided with alternate leaves which are linear-lanceolate, channeled, from two to three feet long, and two or three inches broad at the base. Let the pupils examine specimens, and describe them in all these particulars.

This is one of those plants which has its *stamens* and its *pistils* on different parts of the same plant, instead of growing together in one flower. (See Chart No. XX., Class xix. in Linnæan system; and Fifth Reader, pages 143, 193.) Thus, at the top of the stalk is produced a bunch of *staminate* flowers, of various colors, in a *panicle* of *racemes*, the whole being known as the *tassel*. Each little spikelet will be found to be two-flowered, having *glumes* and *pal'eæ*, and each flower having three *anthers*. The *pistillate* flowers of this plant are a *spike* called the *ear;* and the pistils themselves are what is called the *silk;* and the *glumes* are the *husks*. The kernels are in eight, ten, twelve rows, etc.—always some *even* number, and yellow, white, red, or purple.

(The pupils should be led to notice and describe all these particulars about the *flowers* of the corn. The teacher will find here much matter for cultivating their powers of observation. They will probably suppose that a *flower* consists of a *colored corol'la* only. Tell them that the essential parts of a flower consist of stamens and pistils only. (See Fourth Reader, page 218.) Explain to them the use of the *pollen* of the stamens. If this pollen can not reach the pistil, the latter will produce no seed; and if the pollen of one kind of corn be scattered upon the pistils of another kind, the ear will show a mixture of different kinds of kernels. This effect is often seen when two kinds of corn are planted near each other, as the wind often carries the pollen a great distance. Pupils may themselves try the experiment. When an ear of common corn is just silking out, let them sprinkle the silk, for a few days in succession, with pollen from sweet corn, and when the ear is ripe there will be found kernels like those of sweet corn mingled with

the others. Observation and experiments like the foregoing will be worth, to pupils, more than volumes of unaided reading about the same subjects, and will render their reading much more interesting and valuable to them.)

Indian corn is a native of America, and was unknown in Europe until after the discovery of this country. It is still found growing wild in some of the West India Islands, in Central America, and in the humid forests of Paraguay. (See Fourth Reader, page 193.) Its produce on a given extent of land is greater than that of any other grain. It has the widest geographical range of all the cereals, growing luxuriantly at the equator, and forty or fifty degrees on each side of it. The stalks, like those of the sugar-cane, contain considerable sugar.

Let pupils tell the time and mode of planting corn, hoeing, harvesting, threshing or shelling, quantity raised per acre, legal weight per bushel, uses made of the unground corn, of the meal, etc.

The SUGAR-CANE (*Sac'charum officina'rum*, Lin. S., iii., 2; Nat. M., Glu. End., ord. *Grasses*), although not properly one of the *cereals*, because it does not produce edible *grains*, may, nevertheless, properly be described here, as it belongs to the order of Grasses, the same as maize and the other cereals.

The sugar-cane is a perennial plant, very sensitive to cold, and is, therefore, restricted to the regions bordering on the tropics, where there is little or no frost. It has a solid culm, or stalk, with pith, closely jointed, growing from eight to twenty feet high, erect, with broad, flat, linear-lanceolate leaves like those of maize. It bears its flowers at the top of the stalk, in a panicle from one to two feet in length, composed of numerous, long, thread-like, moderately spreading racemes, which are richly clothed with the long, white, silky hairs that envelope the flowers. (For the appearance of this panicle see page 193, Fifth Reader.) The flowers are in pairs, one *sessile* or *seated* on the spikelet, and the other having a flower stem or *ped'icel*. These flowers have *glumes* and *pal'eæ*, and hence the

sugar-cane is classed among the grasses. Where the plant itself can be obtained, pupils should describe the flowers, etc., from actual observation. Numerous varieties of the cane are cultivated.

The sugar-cane is propagated by cuttings from the root-end, planted in hills or trenches, in spring or autumn. These cuttings send up shoots which in eight, ten, or twelve months, are from six to ten feet high, and fit to be cut down for the mill. They are usually cut before the plant is in flower. A plantation lasts from six to ten years, when the roots, having become old, and having lost their vigor, require to be renewed. The saccharine substance in the cane varies from ten to thirty per cent.; in the beet root, from five to thirteen per cent.

Sugar-mills are merely iron rollers, which are placed in pairs, and between which the canes are passed. The juice thus pressed out is strained, clarified, and boiled into sirup, after which it is crystallized, and is then put into hogsheads having apertures through which the molasses drains into a cistern below. This hogshead sugar is the common Muscovado or brown sugar. Sugar is refined in various ways —by heating the sirup with blood, eggs, milk, etc., and skimming off the impurities which rise, thus producing what is called clayed or loaf sugar, refined sugar, double refined, etc.

The sugar-cane is cultivated extensively in Louisiana, Mississippi, etc., where it formerly produced as many as three or four thousand pounds of sugar to the acre, but, owing to injudicious rotation of crops, and exhaustion of the soil, the product is now seldom more than one thousand pounds to the acre—about one hogshead. By the free use of guano, eight thousand pounds to the acre have been produced in the island of Mauritius.

According to the census of 1850, the cane sugar made in this country amounts to about 248,000,000 pounds annually (248,000 hogsheads, at 1000 lbs. to the hogshead), besides more than nine millions of gallons of molasses. The amount varies greatly in different years. The average an-

nual consumption of sugar in Great Britain is estimated at twenty-four pounds per individual, and in the United States at forty pounds. This latter fact is conclusive that the people of the United States live more comfortably, and even luxuriously, than any other people in the world, because they have more real income to expend in subsistence and its comforts.

The annual production of sugar of all kinds in the world is estimated at about 1,600,000 tons; but in this are included 200,000 tons of beet sugar, and an equal quantity of sorghum and maple sugar—the latter the produce of the United States chiefly.

Let pupils tell and describe the kinds of sugar and molasses with which they are acquainted, prices per pound, gallon, etc., and what purposes both are used for. Also mode of making maple sugar. The average wholesale prices of New Orleans sugar in the city of New York, from 1854 to 1859 inclusive, ranged from 4¾ cents to 9 cents per pound. In 1857 the supply was small, and prices high.

IV. Fruits of Warm Countries.

As vegetation is far more profuse and luxuriant within the tropics than in the temperate and cold regions, so FRUITS are remarkably abundant in the torrid zone, and form there the principal food of the inhabitants. Some of the more important of these tropical fruits, which are often found in our markets, either fresh or preserved in various forms, are here enumerated, with a brief description.

The COCOANUT-TREE (*Co'cos nucif'era*, Lin. S., xix., 6; Nat. M., Agl. End., ord. *Palms*), of which we have given a representation, together with clusters of fruit, both ripe and just forming, is a native of most places within the tropics, and is extensively cultivated for its fruit, juices, oil, etc. It grows from fifty to ninety feet in height, with a straight trunk, and without branches. The leaves are from twelve to fifteen feet long; the flowers, of a pale green color, come out around the top of the trunk in large clusters, in-

closed in a sheath; the nuts succeed them, about 100 to a tree, in clusters of ten or twelve.

The cocoanut, in the husk, is as large as a man's head. If gathered fresh, it is green on the outside; but, as it hardens, it becomes of a reddish brown. It contains about a pint and a half of a liquor-like water, milky, and sweet, and agreeable to the taste. As the shell hardens, the liquor diminishes, till at last it is entirely absorbed by the surrounding white pulpy substance. This latter once constituted the principal food of the natives of many of the islands of the East and West Indies. The cocoanut yields, by pressure, a considerable quantity of oil, which is now much used in manufacturing candles and soap. The *palm oil* from the coast of Guinea is from another species of palm.

For the various uses of the cocoanut-tree, see Fifth Reader, page 189.

The MANGO or MANGO APPLE (*Mangif'era In'dica*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Anacards**) is a fruit as highly valued in tropical, as the peach in temperate climates. It grows on a tree about twenty feet high, which is as extensively cultivated in tropical Asia as apple and pear-trees in this country. It is also found in the West Indies. The fruit is something like a nectarine, but more compressed, longer, and more curved; it is yellow and reddish; its flesh is soft and pulpy; and it contains a large stone covered with coarse fibres. The fruit cuts like an apple, but is more juicy, and is often as large as a big man's fist.

There are many varieties of the mango, differing, like apples, in figure, size, color, and taste. In this country we have only the unripe fruit, which is found in our markets in a pickled state.

The common FIG-TREE (*Fi'cus car'ica*, Lin. S., xx., 3; Nat. M., Ang. Exog., ord. *Morads*†) is a native of the tem-

* From the Greek *ana*, like (in composition), and *kardia*, the heart, in allusion to the form of the fruit of the leading plants of this order, such as the cashew-nut.

† From the Greek *morea*, which was the name of the mulberry. The

perate regions of Asia, where it grows from fifteen to thirty feet in height, producing two or three crops in the same year. It is also extensively cultivated in Southern Europe —in Italy, Southern France, and Spain—for the sake of its delicious fruit, which is about the size of a peach, fleshy, soft, hollow within, and shaped like a top. The cultivated varieties are numerous, with variously colored fruit—bluish-black, red, purple, green, yellow, and white. Figs, when ripe, are for the most part dried in ovens to preserve them, and then packed very closely in the small boxes and baskets in which they are imported. The best figs come from Southern Turkey. Dried figs are also a very considerable article of commerce in France, Spain, and Italy, besides affording, as in the East, a principal article of sustenance for the population. Fig-trees are frequently cultivated in green-houses in our Northern States.

Unlike other fruits, the fig is not produced from any apparent blossom, but is borne, generally singly, upon the young branches, the flower being included in and forming part of the fruit. The floral organs are readily seen in the fresh-gathered fruit, and sometimes also in the thick-skinned, imperfectly ripened dried figs of commerce. The fig is often mentioned in the Old and in the New Testament. The Romans held the fruit in great estimation. Pliny, the naturalist, enumerates twenty-nine varieties that were cultivated in his time. He says of figs, "They increase the strength of young people, preserve the elderly in better health, and make them look younger, and with fewer wrinkles."

The common DATE-PALM (*Phœ'nix dactylif'era*, Lin. S., xx., 3; Nat. M., Agl. End., ord. *Palms*) is a tall, majestic

order is, therefore, that of the *Mulberries*, and includes the mulberries and the figs, and many plants allied to them. The famous banyan-tree is a species of fig. Caoutchouc, or India-rubber, is produced by many plants of this order; and indeed all the India-rubber of Continental India is obtained from the milky juice of a fig-tree—the *fi'cus elas'tica*. Vulcanized India-rubber, a compound of caoutchouc and sulphur, is manufactured into a great variety of useful articles.

tree, with a rugged trunk, having leaves six or eight feet long, with their *pinnæ*, or feather-like side leaves, three feet long, and each little side leaf little more than an inch broad. This tree, like all others of the twentieth class in the Linnæan System, belongs to that class whose staminate and pistillate* flowers grow on separate trees. A drawing of the date-palm is given on the Chart, together with a cluster of dates.

The berry of this tree is the fruit known as the *date* of commerce, upon which a considerable portion of the people of Egypt, Arabia, and Persia almost entirely subsist. A single tree will produce from 100 to 300 pounds of this fruit in one season. It begins to bear at from six to ten years of age, and is fruitful for more than 200 years. In Scripture this palm-tree is very appropriately made the emblem, not only of patience in well-doing, but of the rewards of the righteous—a flourishing old age, a peaceful end, a glorious immortality.†

Of dates there is an endless variety. Generally, however, they may be described as being somewhat in the shape of an acorn, but usually larger, consisting of a thick, fleshy substance, within which is an oblong stone or kernel, having a furrow on one side. The best dates are of a reddish-yellow or orange color on the outside; but when they are allowed to remain on the tree till they are quite ripe, and have become soft, they are often of a bright red color. The Arabs press the ripe fruit into large baskets, and form of it a solid paste or cake; and in the market this cake is cut out and sold by the pound. In Arabia this date-cake forms part of the daily food of all classes of people; and in traveling it is dissolved in water, and thus affords a sweet and refreshing drink. All the refinements of Arabian cookery are exhausted in the preparation of dates; and the Arabs

* In botany, the *staminate* flowers are called the *male* flowers, and the *pistillate* the *female*, as it is only the latter which produce the seed, fruit, etc. It is therefore only the *female* date-tree that produces dates.

† See the Song of Solomon, vii., 6, 7; Psalms, xcii., 12, 14; 1 Kings, vi., 29; Lev., xxiii., 40, etc.

say that a good housewife will daily supply her lord, for a month, with a dish of dates differently dressed.

The STONE PINE (*Pi'nus pi'nea*, Lin. S., xix., 15; Nat. M., Gym. Exog., ord. *Conifers*), represented on the Chart, is the *cone* of a species of pine found not only in the forests of Syria, but also in Southern Italy. It was called by the Latins *Nux pinea*, or pine-nut. The trees of the stone pine, which grow to the height of forty feet, are much planted in the gardens and villas of Rome and Florence, and there is an immense forest of them in Ravenna, in Italy. The cone, when ripe, and when thoroughly dried, or thrown for a few minutes into the fire, separates into many compartments, from each of which drops a smooth white nut, in shape like the *seed* of the date. The *shell* of the nut is very hard, and within it is the fruit, which is much used in Syria in various preparations of rice and in sweetmeats; and throughout Italy the fruit is an article of commerce, and is eaten both by the poor and the rich. The fruit is sweet, somewhat like almonds, but with a slight flavor of turpentine.

The OLIVE-TREE (*O'lea Europæ'a*, Lin. S., ii., 1; Nat. M., Ang. Exog., ord. *Oliveworts*) is a pale evergreen, from fifteen to thirty feet in height, a native of Syria, Greece, and Northern Africa. It is also found in different parts of France, Spain, and Italy, where numerous varieties have been produced by cultivation. It produces an immense number of white flowers.

The wood of the olive-tree is heavy, compact, fine-grained, and brilliant, of a reddish or yellowish tint, and is employed by cabinet-makers to inlay the finer species of wood, which are contrasted with it in color, and to form light articles of ornament, such as dressing-cases, snuff-boxes, etc. The wood of the roots is beautifully marbled.

But the chief value of this tree is the *oil* obtained from its fruit, which is used as a substitute for butter in all the countries where the olive grows, and is largely exported as an article of commerce for use at table in preparing salads. The fruit of the olive is a kind of plum, egg-shaped,

from three fourths of an inch to an inch and a half in length, with a smooth skin, which is generally of a violet color when ripe; but in certain varieties it is of various shades of red, yellow, and purple-black. The pulp is greenish, and within it is an oblong pointed stone, having two cells. The oil of the olive is furnished by the *pulp*, which is a characteristic almost peculiar to this fruit; whereas the oil from most other vegetables is produced from the *seeds*, nut, or kernel. What is called *sweet oil* is olive-oil.

The oil is obtained by pressing the pulp, but without breaking the stone. It is received into vessels half filled with water, from which it is skimmed, and put into tubs, barrels, and bottles for use. The best olive-oil is of a bright pale amber color, without smell, and bland or mild to the taste. If kept too long, and especially in a warm place, it becomes rancid. The very best of the olive-oil is that called *Florence* oil, produced in the vicinity of Florence, and generally imported in flasks surrounded by a kind of network formed of leaves. *Lucca* oil is usually imported in jars holding about nineteen gallons each. *Geneva* oil is a fine kind. *Gallipoli* oil, from Gallipoli, in Southern Italy, is the kind chiefly imported into England. *Sicily* oil is of an inferior quality, and *Spanish* oil is the poorest. Olive-oil is the chief article of export from the kingdom of Naples.

In Syria almost every dish is cooked in olive-oil, and the poorer kinds are used for lamps and the manufacture of soap. The green berry is also pickled, after being steeped in water some days to remove its bitter taste; and as a pickle it forms an important article of commerce, generally under the name of *Picholines*, after one Picholini, an Italian, who first discovered the art of pickling olives. The olive is also eaten in its ripe state, without any preparation, except, perhaps, with the addition of a little pepper and salt.

The olive is a tree of slow growth, seldom producing berries before the seventh year; but it lives several hundred years—sometimes a thousand or more—and it bears

abundantly to the very last, so long as there is a fragment of green wood remaining.

In the Bible are numerous beautiful allusions to this tree, many of which can not be understood without a knowledge of its character and habits. The olive has been the emblem of peace among all nations, and the symbol of wisdom, abundance, and prosperity of every kind. Among the ancients the oil was the emblem of joy and gladness; it was employed by the Greeks in pouring out libations to their gods, while the branches formed the wreaths of the victors of the Olympian Games. "The trees went forth on a time to anoint a king over them; and they said to the olive-tree, Reign thou over us."—*Judges*, ix., 8.

The POMEGRANATE (*Pu'nica grana'tum*, Lin. S., xi., 1; Nat. M., Ang. Exog., ord. *Myrtleblooms*) bears considerable resemblance, in its wild state, to the common hawthorn; but when cultivated in gardens and plantations, it changes from a thorny bush to a handsome tree, fifteen or twenty feet in height. Its leaves are of a beautiful green, opposite, about three inches long, half an inch to an inch broad in the middle, and the flowers, which are bell-shaped, are very fragrant, and of a bright scarlet color. The fruit, which is very beautiful to the eye and pleasant to the taste, is a pulpy, many-seeded berry, nearly round, encircled at the end opposite the stem with something resembling a crown, and covered with a thick, brittle rind. It is about the size of a large orange, and, when perfectly ripe, varies in color from bright yellow or green to a dark red. The pulp has a reddish color, and a pleasant sub-acid taste. Several varieties are cultivated, not only for their fruit, but also as ornamental trees, and in some places as a hedge plant. It is found native in Northern Africa, Persia, Japan, and various parts of Asia, and has long been naturalized in the south of Europe, the West Indies, Mexico, and in South America.

The value of the fruit of the pomegranate depends on the smallness of the seed and the largeness of the pulp. The Persians cultivate a variety which is nearly seedless,

and which is imported from Cabul and Candahar, where the pomegranate grows in perfection. In hot countries the juice of the pomegranate assuages thirst in a degree most peculiar to it, from its pleasant acid, which is described by Moore as "full of melting sweetness."

The pomegranate-tree partakes of the antiquity of the vine, the fig, and the olive, and in point of utility is numbered with the grain-bearing plants and with honey, all constituting the principal food of Eastern nations in the early stages of civilization. The Romans called it the *Carthaginian apple*, because first brought to them from Carthage. It is frequently mentioned in the Old Testament. While the Israelites sojourned in the wilderness it was selected as one of the ornaments of the robe of the ephod. The two pillars of brass made by Hiram for the porch of Solomon's Temple were ornamented with carvings of the pomegranate. Solomon speaks of "an orchard of pomegranates, with pleasant fruits;" and it is mentioned as one of the fruits discovered in the "Promised Land:" "A land of wheat, and barley, and vines, and pomegranates, a land of olives, and honey."—*Deuteronomy*, viii., 8.

The BANANA (*Mu'sa sapien'tum*, Lin. S., v., 1; Nat. M., Agl. End., order *Musads*), a species of the plantain-tree, a native, chiefly, of the plains of the tropics, and found abundantly in the East and West Indies, Syria, etc., grows from fifteen to twenty feet in height, having leaves from three to ten feet in length, and nearly two feet in width. A variety of the banana—the plantain-tree proper—is extensively cultivated in Mexico. The fruit of both, from five to nine inches in length, and about an inch in diameter, is at first green, but when ripe is of a pale yellow color, and in some kinds dark purple. The fruit of the true banana is shorter and rounder than that of the plantain, and has a softer pulp. The skin is peeled off, and the inside eaten, which is of a sickish sweet taste, and a doughy feel in the mouth. People are not apt to like these fruits at first, but soon become extravagantly fond of them. It is the fruit of the plantain-tree proper (*Mu'sa paradisi'aca*)

which, under the name of banana, is so abundant in the markets of New York and other cities in early summer.

When the plantain or banana plant is full grown, the spike of flowers, of a pink color, appears from the centre of the leaves, nearly four feet in length, and nodding on one side. When these spikes are filled with fruit they are often so large as to weigh more than forty pounds. Formerly this fruit was called Adam's apple, from a notion that it was the forbidden fruit of Eden; while others supposed it to be the grapes brought out of the promised land by the spies of Moses.

This fruit in Mexico is used, not merely as an occasional luxury, but rather as an established article of subsistence, as it forms a principal part of the principal food of the people. It is not only eaten fresh, but it is roasted or boiled; it is also made into tarts, sliced and fried with butter; it is also dried and preserved as a sweetmeat. A fermented liquor is made from the fruit, and, in some countries, a cloth from the fibres of the trunk. The leaves make excellent mats, and are also used for making baskets and for thatching cottages.

A plantation of bananas requires little care, and the product to the acre is said to be, to that of wheat, as 130 to 1 of nutritive substance, and to that of potato as 40 to 1. The apathy and indolence of the natives in the hot regions of Mexico has been ascribed, and probably with good reason, to the facility with which this fruit supplies them with subsistence.

The PINE-APPLE (*Brome'lia ana'nas*, Lin. S., v., 1; Nat. M., Agl. End., order *Bromelworts*), a native of South America, and now extensively cultivated in all warm climates, is a short-stemmed or stemless plant, growing about four feet high, with rigid leaves fringed with spines, producing in their centre a large conical spike of purple flowers; and this spike, with its bracts, stem, etc., becomes blended into one fleshy mass, forming the conical fruit. The cultivated fruit is well known for its sweetness and fine aromatic flavor; but in its wild state the fruit is excessively acid,

burning the gums. It is now considered one of the most important fruits in the world. Many varieties have been produced by cultivation. It is found abundantly in our sea-port towns in the summer season, being brought by ship-loads. In the West Indies and South America, one species, in its wild state, is used for fencing pasture-lands, for which purpose it answers well on account of its strong prickly leaves.

The BREAD-FRUIT-TREE (*Artocar'pus inci'sa*, Lin. S., xix., 1; Nat. M., Ang. Exog., ord. *Artocarps**) grows in the South Sea Islands, 30 or 40 feet high. It has alternate, deeply-gashed, bright-green leaves, about two feet long; and the whole tree, and the fruit before it is ripe, abound in a very tenacious milky juice. Like all plants of the nineteenth Linnæan class, it has the pistillate and staminate flowers separate on the same plant. The staminate flower is a club-shaped catkin, as seen on the right of the lower part of the cut on the Chart; and the pistillate or female flower consists of numerous pistils, with their ovaries or seed-vessels arranged over a fleshy receptacle, which becomes a globe-like berry or fruit. This fruit is of a pale green color, about the size of a child's head, marked on the surface with irregular six-sided depressions, and containing a white and somewhat fibrous pulp. The eatable part, lying between the skin and the core, is as white as snow, and somewhat of the consistence of new bread. It is roasted before being eaten, or boiled or fried in palm-oil. The natives of Otaheite cultivate eight or nine varieties. This fruit has been introduced into the West Indies, but it is there considered inferior to the banana, which produces even more bountifully than the bread-fruit.

The ORANGE-TREE (*Cit'rus auran'tium*, Lin. S., xii., 1;

* From the Greek *artos*, bread, and *karpos*, fruit—the BREAD-FRUITS. In this order are found not only the eatable bread-fruits, and the cow-tree of South America, which yields a copious supply of rich and wholesome milk, but also the poisonous upas-tree of Java. The order of Artocarps is nearly allied to the *Morads* already described; and some of the artocarps also produce caoutchouc or India-rubber.

Nat. M., Ang. Exog., ord. *Citronworts*) is an evergreen, attaining a height of from fifteen to twenty-five feet, having beautiful green, ovate, oblong, and acute leaves, and a trunk of a delicate ash-gray. Its native country is undoubtedly China; but it is now extensively cultivated in all warm countries, and is also a favorite in Northern green-houses. The flowers of the sweet orange are of a delicate white, but in the acid varieties they are slightly tinged with pink. They are delightfully fragrant; and as the tree is at one and the same time in all stages of its bearing—in flower, in green and in ripe fruit, inviting the "hand to pull and the palate to taste"—it is hardly possible to conceive or imagine any object more delightful.

The fruit of the orange is spherical, with a reddish or orange-colored rind. This external covering is of a spongy texture, with but little juice or sap, but containing numerous little glands which secrete an acrid, volatile oil, very inflammable, and of a strong pungent taste. The interior of the fruit is usually divided into from nine to twelve carpels or cells, which contain the pulp, seeds, and juice; and these cells are divided by a whitish leathery skin, radiating from the centre to the rind. The cells may thus be easily separated without wasting the juice. In some varieties the seeds are entirely wanting, a result supposed to have been attained by repeated removes from the original stock by grafting.

There are almost as many varieties of the orange as of the apple. From the flowers, fruit, and leaves of the *Bergamot* variety is obtained the essence known by that name. The pulp of the bitter or Seville orange, boiled with sugar, makes an excellent *marmalade*. The productiveness of the common orange is enormous, as, according to Lindley, a single tree has been known to produce 20,000 oranges fit for packing, exclusive of the damaged fruit and waste, which may be calculated at one third more. The fruit of the orange may be obtained fresh in any region of the globe, and at almost every season of the year. The principal imported varieties are the *Maltese*, of a reddish, deli-

cious pulp; the large *Havana*, sweet, with a rough rind; the *St. Augustine*, still larger than the Havana, and containing about 240 oranges to the bushel; the *Valencia;* the *Sicilian*—rather acid, and the *Provence*, and the *Genoese*. There are also Seville, Oporto, *Malaga*, etc., and the bitter oranges of Cuba and Florida, of a beautiful color, but unfit to be eaten, on account of their bitter flavor.

In this same order of *Citronworts* are the lemon, lime, citron, and shaddock, nearly allied to the oranges.

The *Lemon*, the well-known fine acid fruit of commerce, is oblong, and of a greenish-yellowish color. The juice of lemon, or citric acid, as it is often called, may be preserved in bottles for a considerable time by covering it with a thin stratum of oil, to keep it from the air. It is used to make lemonade, and to flavor sirups, etc. The *Lime* is a spherical fruit, smaller than the lemon, and somewhat inferior to it, but is much esteemed in the green state for preserves. The *Citron* is a rough fruit, oblong, with a very thick rind, larger than the largest lemon, but inferior in the quality of its acid. The candied citron of the confectioners is made from its skin. The fruit of the *Shaddock*, which is spherical, and has a thick, white, and bitter rind, grows in Japan to the size of a child's head. It is a worthless fruit; but it furnishes the best stocks for grafting the orange and lemon.

CHART No. XXII. ECONOMICAL USES OF PLANTS—*continued.*

V. Medicinal Plants.

The RHUBARB (*Rhe'um palma'tum*, Lin. S., ix., 3; Nat. M., Ang. Exog., ord. *Buckwheats*) is an important medicinal plant, a native of China and Tartary, whence large quantities of the dried *root* are exported. The best is that which reaches us by the way of Russia, and which is improperly called "Turkey" rhubarb. The color of the root is a lively yellow, streaked with red and gray. Its texture is dense,

and, when reduced to powder, it is entirely yellow. The odor of the root is peculiar, and its taste is nauseous, bitter, and astringent. The leaves are palmate and acuminate, as shown on the Chart.

The rhubarb known in this country as the garden rhubarb, or pie-plant, and the leaf-stems or petioles of which are so extensively used for making pies, is the *Rhe'um rhapon'ticum*, the root of which is quite similar, in its medicinal properties, to the imported rhubarb, but less powerful. Its leaves are very large, generally obtuse, and heart-ovate; stem stout and fleshy, hollow, growing from three to four feet high, and producing dense clusters of greenish-white flowers. Its form is in every respect like that of the Turkey rhubarb represented on the Chart, with the exception of the leaves.

The SARSAPARILLA (*Smi'lax sarsaparil'la*, Lin. S., xx., 6; Nat. M., Agl. End., ord. *Sarsaparillas*) is a half shrubby plant, well known as a drug, growing about four feet high, with a prickly quadrangular *stem*, but having the *branches* unarmed; leaves oblong-ovate, acuminate, three to six inches long and half as wide, with tendrils starting from the base of the petioles; flowers white and green, or yellowish; berries large and globular, and of a bright pink-red when fully ripe; root long, slender, and creeping, covered with a wrinkled bark, which in some varieties is brown, but that from Jamaica is deep red.

The bark of the root, which is the only useful part of the plant, is inodorous, and has a mucilaginous, slightly bitter taste. The roots are imported in bales from Brazil, the West Indies, Honduras, and Vera Cruz. Many species of the smilax—some found in Asia, and some in North America—have the same medicinal properties as are found in the genuine drug. Preparations of sarsaparilla have been a very popular medicine in the United States as a restorative to debilitated constitutions. In India the juice of the fresh tuber of one species is taken inwardly, and applied externally, for the cure of rheumatic affections.

JALAP (*Ipo'mea pur'ga*, or *Exogonium pur'ga*, Lin. S.,

v., 1; Nat. M., Ang. Exog., ord. *Bindweeds*), so named from Jalapa, in Mexico, whence it is chiefly imported, is a powerful cathartic medicine, the root of a climbing or creeping plant, which grows about ten feet in length. It belongs to the same order of plants as our Morning-glory, Cypress-vine, Bindweeds, etc.

The Jalap plant has a tuberous perennial root (as represented at *b* on the Chart), the taste of which is exceedingly nauseous, accompanied by a sweetish bitterness; it has a smooth, twining, annual stem; a salver-shaped, red corolla, with a long cylindrical tube. The leaves, which are cordate-ovate, resemble those of the ivy. The flowers open only at night.

The root, when brought to this country, is in thin slices. The dark, heavy, and resinous roots are the best; but inferior kinds are often ground up with the genuine drug. The powder is of a yellowish-gray color. It is estimated that 200,000 pounds of the pure Jalap, from Jalapa, are annually exported from Vera Cruz. The root of a single plant rarely exceeds a pound in weight.

The POPPY (*Papa'ver somnif'erum*, Lin. S., xii., 1; Nat. M., Ang. Exog., ord. *Poppyworts*), from which the drug called *opium* is obtained, supposed to be a native of Asia, but now found growing wild throughout Southern Europe, is an annual herb, with a stem growing from two to four feet high; leaves large, gashed, clasping the stem, and resembling those of the lettuce; flowers white, with four petals in the wild state, but increasing in numbers by cultivation, and resembling the flowers of the tulip; flower-buds nodding, but erect in flower and in fruit. The seeds, which are small, but very numerous, are produced in a large roundish capsule, which has openings at the top when ripe.

All parts of the poppy contain a white, opaque, narcotic juice; but as this juice abounds most in the capsules, these are the parts of the plant from which the drug is obtained, by the following process. When the capsules are half grown, longitudinal incisions are made, through their outer

coating only, at sunset, and in the morning the juice which has flown from them is scraped from the capsules by women and children. This juice is afterward worked in the sunshine until it has attained a considerable degree of thickness, when it is formed by hand into cakes, and farther dried, in which form it is sold as opium. The best opium is of a reddish-brown or fawn color; it has a strong, heavy, narcotic odor, and a bitter taste, accompanied by a sensation of acrid heat, or biting on the tongue and lips, if it be well chewed.

The opium-poppy is very extensively cultivated in British India, Persia, and Turkey. It grows readily in the middle and southern United States also, but, on account of the high wages of labor here, its cultivation for the sake of the drug would not seem to be profitable. From the seeds is obtained a wholesome oil, which possesses none of the narcotic properties of the drug. Olive-oil is often adulterated with it.

As a medicine, opium acts at first as a powerful stimulus, soon followed by narcotic and sedative effects, destroying the irritability of the stomach, and allaying pain in the most distant parts of the body. In moderate doses it increases the fullness, force, and frequency of the pulse, augments the heat of the body, quickens respiration, and invigorates both the corporeal and mental functions, exhilarating even to intoxication; but by degrees these effects are succeeded by languor, lassitude, and sleep, and, in many instances, by headache, sickness, thirst, tremors, and other symptoms of debility, such as follow the excessive use of ardent spirits. In very large doses the pulse is at once diminished; drowsiness and stupor immediately come on, and are followed by delirium, heavy breathing, cold sweats, convulsions, apoplexy, and death.

But, notwithstanding these effects, opium is extensively used in Turkey, India, and China, both in chewing and in smoking, for the purpose of exhilarating the spirits; but it is found necessary, in order to produce the same agreeable effects, gradually to increase the quantity taken. Hence the great danger arising from its habitual use.

The peculiar sedative principle of the opium is found in a crystallized salt called *morphine*, which is extracted from the drug. The total amount of opium imported annually into the United States is about 150,000 pounds, valued at about 480,000 dollars.

SENNA (*Cas'sia Orien'talis*, Lin. S., x., 1; Nat. M., Ang. Exog., ord. *Leguminous Plants*), well known as a mild cathartic, is an annual plant, growing from three to five feet high, with pinnate leaves in five pairs, as shown on the Chart, and bright yellow flowers, succeeded by legumes or pods similar to those of the bean. This is the true senna, imported chiefly from Western Asia and Eastern Africa; but the senna of the shops consists of several species, all possessing similar qualities.

The *Cas'sia marilan'dica*, a species found growing wild in this country, in dense masses in alluvial soils, and often cultivated in gardens, is also used as a cathartic. The upper leaves and flowers are gathered for this purpose. This species is a *perennial*, and has the pinnate leaves generally in *eight* pairs; flowers of five bright yellow petals; legumes or pods curved; and from twelve to twenty-seeded.

IPECAC, as it is generally called, but, more properly, IPECACUANHA (*Cephae'lis ipecacuan'ha*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Cinchonads*), is a little, half-herbaceous, perennial plant, found in damp shady forests in Brazil. The root of this plant holds the first rank among emetics. It is also sudorific (producing perspiration) and expectorant.

This plant has a weak creeping stem two or three feet long, from which it sends out roots, as seen on the Chart. The roots are contorted, from four to six inches long, and about as thick as a goose-quill. There are several varieties of this root, denominated, from their color, the white, gray, and brown, which are imported in bales from Rio Janeiro. The entire root is inodorous; but the powder, in which form it is used, has a faint disagreeable odor. The taste is bitter, and exceedingly nauseous. Helvetius, who first gave this root celebrity in France, in the time of Louis

XIV., received, as a reward from that monarch, a gift of five thousand dollars.

GENTIAN (*Gen'tiana lu'tea*, Lin. S., v., 2; Nat. M., Ang. Exog., ord. *Gentianworts*) is a plant which grows about four feet high, having broad ovate leaves, opposite and sessile, and a yellow axillary corolla, usually five-cleft, whorled, and rotate or wheel form. The thick root, which is of a yellowish-brown color, and very bitter taste, is a powerful tonic, and the principal European bitter used in medicine. In Switzerland and Germany this plant occupies extensive tracts of ground untouched by any cattle. The gentian brought to this country comes chiefly from Germany. A species of gentian having *blue* flowers is often used as a substitute for the yellow species.

The gentians are a large order of beautiful plants, found in nearly all parts of the world, and many of them cultivated in our gardens for ornament. They present a great variety of colors—red, blue, yellow, and white, with many of the intermediate compound tints.

PERUVIAN BARK (*Cin'chona condamin'ea*, Lin. S., vi., 1; Nat. M., Ang. Exog., ord. *Cinchonads*), much used in medicine as a powerful febrifuge, is obtained from several species of plants, of the genus Cinchona, found in Peru. This genus derived its name from the Countess of Cinchon, who was cured of a fever by the use of this plant. The flowers of the kind most used in medicine are pink, and the seeds are contained in a long yellow capsule. Three kinds of the Peruvian bark, obtained from different species of Cinchona, are found in our drug-stores—the pale bark, the red, and the yellow. All are exceedingly bitter to the taste, and used for the same purposes.

The medicinal properties of the Peruvian bark, and of most of the plants of the genus Cinchona, depend upon the presence of two alkalies, cinchonia and quinia. The latter, extracted from the bark, and popularly known as *quinine*, is much used in the treatment of agues.

The CASTOR-OIL PLANT (*Ri'cinus commu'nis*, Lin. S., xix., 15; Nat. M., Ang. Exog., ord. *Spurgeworts*), though an an-

nual and herbaceous plant in our gardens, becomes in warmer climates a tree of several years' standing. In our gardens, when started early in a hotbed, it makes a magnificent border annual, often attaining a height of ten or twelve feet.

The leaves of this plant, which are from four inches to a foot in diameter, and on long petioles, are peltate, palmate, and serrate, with lanceolate lobes; flowers greenish-yellow; lower stem has a frosty or mealy appearance, with branches of a light bluish-green color. The capsules (as represented at *d* on the Chart) containing the seeds or beans are prickly.

The castor-oil of commerce, noted as a mild and safe cathartic, is obtained from the seeds or beans, either by boiling them in water or by pressure; but the latter method is the best. The oil is thick and heavy, nearly inodorous, insipid, and of a very pale straw-color.

The castor-oil plant has been raised extensively in Southern Illinois. It is planted in the spring, when there is no longer danger of frosts, much in the manner of Indian corn, with the exception that but one seed is put into each hill, and that at every fourth row a space is left sufficiently wide to admit of the passage of a team for the purpose of gathering the crop. The plant bears at the same time flowers and fruit, continuing to blossom, in our climate, as long as warm weather continues. The ripening commences in August, and the crop is gathered at intervals from this time until the plants are destroyed by frost. From sixteen to twenty-five bushels of the beans are obtained to the acre. The oil is manufactured extensively in St. Louis. During the fall of 1854 one establishment in St. Louis manufactured 32,000 gallons of castor-oil. The wholesale price of the oil has varied from sixty cents to $1 25 per gallon, sold in quantities by the barrel. Castor-oil would be very valuable for lubricating machinery if it could be produced at a sufficiently low price.

VI. Plants used for Beverages.

"Various artificial drinks," says Professor Johnston, in his Chemistry of Common Life, "are prepared, both in civilized and semi-barbarous countries, and are in daily use among vast multitudes of men, such as tea, coffee, and cocoa, beer, wine, and ardent spirits, the preparation and effects of each of which are connected with interesting chemical considerations.

"These drinks agree in being all prepared from, or by means of, substances of vegetable origin, and in being generally classed among the luxuries rather than the necessaries of life. The mode in which they are prepared, however, naturally divides these drinks into two classes. Tea, coffee, and cocoa are roasted and prepared before they are infused in water, and the infusion is then drunk without farther chemical treatment. These are simply *infused* beverages. Beer, wine, and ardent spirits are prepared from infusions which, after being made, are subjected to important chemical operations. Among these operations is the process of fermentation, and hence they are properly distinguished as *fermented* liquors. The infused beverages are drunk hot; fermented liquors are usually taken cold."

Among the infused beverages, the *teas*, *coffees*, and *cocoas* are the most important. *Teas* are infusions of leaves; *coffees* are infusions of seeds; while *cocoas* are, properly, soups or gruels, made by diffusing, through boiling water, the entire seeds of certain plants previously ground into a paste.

The TEA PLANT of China (*The'a vir'idis*, Lin. S., xii., 1; Nat. M., Ang. Exog., ord. *Theads*) is a hardy, evergreen, bushy shrub, from three to six feet high; leaves numerous, lanceolate, serrate, flat, three times as long as broad, and on short and thick channeled footstalks; blossom white, with yellow style and anthers. At *c*, on the Chart, is shown the pistil of the plant and one of the stamens; at *b* is the pistil farther advanced, with the seed-vessel at the bottom; at *d* the seed-vessel or boll; and at *a* the same

fully ripe and opening. The *leaves*, which are the valuable part of the plant, have been used as a beverage in China from very remote periods, and their consumption is now enormous. The total annual produce of the dried leaves in China alone is now estimated at more than a million of *tons!* Large quantities are also produced in Japan, Corea, Assam, and Java.

Although we have various kinds of black and green teas in the market, yet, botanically considered, the tea-plant is a single species; the green and black, with all the diversities of each, being mere varieties, like the varieties of the grape, produced by difference of climate, soil, locality, age of the crop when gathered, and modes of preparation for the market. The tea-plants are raised from seeds, which are planted three or four in a hill, the hills being about four feet apart, and the same distance between the rows. A tea-plantation in China is said to look, at a little distance, like a shrubbery of gooseberry bushes. The leaves are not collected until the plants are three years old; and after the plants have grown nine or ten years they are cut down, in order that a new plantation may then be made, or that young shoots from the old roots may spring up. The first gathering, in China, commences about the first of March, when the leaves just begin to unfold from the bud. These furnish the most costly of the "green" teas, and are said never to be exported, and to be used only by persons of the highest rank in China. A second gathering of the "green" teas, about a month later, furnishes those known as imperial and young hyson skin; at later gatherings are obtained the hyson, hyson skin, and gunpowder teas; and lastly, in June, the "black" teas, such as souchong and congo, until they reach the latest crop and lowest in quality, called by us "bohea," and by the Chinese large tea, on account of the maturity and size of the leaves.

The process of gathering the tea is one of great nicety and importance. Each leaf is plucked separately from the twig, mostly by women and children, and great care is taken to have the hands of the gatherer kept clean. In

collecting some of the finer sorts that are used by the Chinese nobility only, it is stated, upon reliable authority, that the gatherer is obliged, for some weeks previous, to abstain from all gross food, lest his breath or perspiration might injure the flavor, to wear fine gloves while at work, and to bathe two or three times a day during this period.

After the gathering of the tea, the operation of drying and rolling is performed, the object being to expel the moisture from the leaves, and, at the same time, to retain as much as possible of their aromatic flavor. For this purpose the leaves are thrown into shallow, heated roasting-pans, kept constantly in motion, and, when sufficiently moist and wilted, are placed upon a table, and rapidly rolled with the hands. After properly drying, the tea is winnowed, and passed through sieves of different sizes, in order to get rid of the dust and other impurities, and to divide it into the different grades, which have their respective names. By various processes of heating, rolling, etc., differences of flavor and color are produced. And yet it has been ascertained that the beautiful *blue* tinge which our finest teas possess is given by dyeing them with Prussian blue—a well-known poison! The Chinese do not use such teas, but say that they color them in this manner because they thus better suit the taste of the "foreign barbarians!"

(For a further account of tea, tea-drinking, etc., see Fifth Reader, page 155. It would be well for pupils to describe the process of making tea, the kinds with which they are acquainted, or which are kept in the stores, prices per pound, etc.)

EFFECTS.—Tea exhilarates, by acting on the nervous system, without sensibly intoxicating. Hence it excites the brain to increased activity, and produces wakefulness, and is therefore a popular beverage with those who are obliged to keep awake nights, and to persons who perform much mental labor. It also soothes and stills the vascular system (the system of the blood-vessels), and hence its uses in inflammatory diseases, and as a cure for the headache.

Green tea, when taken strong, acts very powerfully upon some constitutions, producing nervous tremblings and other distressing symptoms, acting as a narcotic, and in inferior animals even producing paralysis. *Black* tea, made from more mature leaves than green tea, is the least injurious, because it does not contain so much of the volatile oil as the green varieties.

The quantity of tea consumed in Great Britain annually is about seventy millions of pounds, or two and a half pounds to each individual; while the United States now consume about thirty-two millions of pounds annually, or but little more than a pound to each individual. The quantity consumed annually in the whole world is estimated at 2240 millions of pounds, and it is said to be used by 500 millions of mankind.

The COFFEE-TREE (*Coffe'a Ara'bica*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Cinchonads*), a native of Ethiopia and Abyssinia, but first brought to notice from Arabia, is an evergreen from fifteen to twenty feet high; stem four or five inches in diameter, with a light-brown bark; opposite, oblong, wavy, shining, light-green leaves; flowers white, in clusters at the base of the leaves, deeply five-cleft, with spreading divisions, and of a grateful odor, but of short duration. When the tree is full grown it much resembles one of our apple-trees, with the lower branches bent nearly to the ground. In almost all seasons of the year blossoms and green and ripe fruit may be seen on the tree at the same time.

When the blossom falls off there remains in its room, or rather springs from each blossom, a small fruit, green at first, but which becomes red, or of a reddish-orange color, as it ripens, and is not unlike a large cherry, and is very good to eat. Under the flesh of this cherry, instead of the stone is found the bean or berry we call coffee, wrapped round in a fine thin skin. The berry is then very soft and of a disagreeable taste, but as the cherry ripens, the berry in the inside grows harder, and the dried up fruit, being the flesh or pulp of it, which was before eatable, becomes

a shell or pod of a deep brown color. The berry is now solid, and of a clear transparent green in some varieties, and a brownish or pale yellow in others. Each shell contains one berry, which splits into two equal parts. When the fruit is sufficiently ripe to be shaken from the tree, the husks are separated from the berries, and are used in Arabia by the natives instead of the berries, while the berries are exported for the European markets. The leaves, when cured in the manner of tea, are said to possess all the virtues of the berry itself. The full-grown fruit, and one with the berry exposed, are represented on the Chart.

In extensive coffee plantations the plants are put out about eight feet apart; they are then topped and stunted to about five feet in height, for the convenience of having the fruit within reach of the gatherer. Thus dwarfed, they extend their branches until they cover the whole ground. They begin to yield fruit the third year; by the fifth, sixth, or seventh, they are at full bearing, and continue to bear for upward of twenty years. The different kinds of coffee found in our markets—such as Java, Mocha or Arabian, La Guayra, Ceylon, etc.—are all of the same original kind, but changed somewhat in appearance and quality by differences of soil, climate, and cultivation.

Before the berry is available for use it undergoes a process called roasting; and the valuable properties of the coffee depend very much on the manner in which this process is performed. It is said that, "If coffee be underdone in roasting, its virtues will not be imparted, and it will load and oppress the stomach; if it be overdone, it will yield a flat, burnt, and bitter taste, its virtues will be destroyed, and in use it will heat the body and act as an astringent."

The effects of coffee are thus described by Professor Johnston. "It exhilarates, arouses, and keeps awake; it allays hunger to a certain extent, gives to the weary increased strength and vigor, and imparts a feeling of comfort and repose. Its physiological effects upon the system, so far as they have been investigated, appear to be that,

while it makes the brain more active, it soothes the body generally, makes the change and waste of matter slower, and the demand for food in consequence less." It must be admitted, however, that a less favorable opinion of the effects of coffee upon the system is given by many other writers.

Coffee is cultivated to a considerable extent in the West Indies, but very largely in Brazil. The entire annual production of coffee in the world is now estimated at six or seven hundred millions of pounds, and probably more than half of this quantity is raised in Brazil. One hundred millions of mankind are believed to use it. It is estimated that more than two hundred and twenty millions of pounds are annually consumed in the United States alone, while only forty millions of pounds are consumed in Great Britain. We are, therefore, as a people, the greatest coffee-drinkers in the world.

(If we now number thirty millions of people, how much coffee, on an average, is annually consumed by each individual? Calling the price paid 14 cents per pound, what would the sum thus paid for coffee amount to? What kinds of coffee are the pupils acquainted with? What kinds are found in the stores, and what are the prices per pound?)

The PARAGUAY TEA-PLANT, or MATÉ (*I'lex Paraguayen'sis*, Lin. S., iv., 3; Nat. M., Ang. Exog., ord. *Hollyworts*), is a shrub or small tree, from ten to fifteen feet high, growing spontaneously in the forests of Paraguay. Flowers white, berries reddish-orange. The leaves, four or five inches long, when dried, and rubbed to powder, are extensively used throughout nearly all South America, for making a tea called *maté*. These leaves contain the same active ingredients as Chinese tea, and the beverage made from them produces similar effects; but excessive use of it is attended with more dangerous consequences, as it is apt to induce diseases similar to those which follow the excessive use of ardent spirits—producing intoxication, and leading even to *delirium tremens*. The quantity of the dried

leaves used in South America is very large, as five or six millions of pounds are annually exported from Paraguay. The entire consumption of this plant, annually, is believed to be about twenty millions of pounds. Ten millions of people in South America make it their common beverage.

Mankind seem to have almost a *natural* taste for stimulating, intoxicating, and narcotic drinks; as in all countries, civilized and savage, drinks of some of these kinds are common.

The COCOA-TREE (*Theobro'ma caca'o*, Lin. S., xii., 1; Nat. M., Ang. Exog., ord. *Byttner'iads*), or Chocolate-tree, is the tree that produces the seeds from which the well-known beverage called *coco'a*, or *chocolate*, is produced. This tree, which is from twelve to sixteen feet high, grows spontaneously in Mexico and Central America, and forms whole forests in Demarara. In general appearance it resembles, both in size and shape, a *black-heart* cherry. The leaves are lanceolate-oblong, bright green, entire; flower small, reddish, inodorous; and the fruit, which, like the fig, grows directly from the stem and principal branches, is of the form and size of a small oblong melon or thick cucumber, and about three inches in diameter at the thickest part. This fruit is smooth, yellow, red, or of both colors externally, having a yellowish fleshy rind, near half an inch in thickness; within this rind is a whitish or cream-colored spongy pulp, and imbedded in this latter are from six to thirty beans or seeds, of the size of large almonds. At *d* on the Chart is represented one of the fruits, with a part of the rind removed, and showing the beans or seeds in rows. These seeds are of a flesh-color when fresh, but they become of a dark brown, both externally and internally, when fully ripe and dry. They taste like a rich nut, but are slightly astringent, and decidedly bitter before being roasted. The cocoa-tree begins to bear in its third year, producing, after this period, leaves, flowers, and fruit, all the year through. A tree yields from two to three pounds of seeds annually.

The seeds or beans are usually roasted like coffee, then

ground or pounded, and mixed with water, so as to form a thick paste; sugar, vanilla, and sometimes cinnamon and cloves, and some other ingredients, are then added, with, usually, the reddish-yellow vegetable dye anotta to color it; and when the paste thus formed has become hardened into cakes, it forms the *chocolate* of the shops. What is properly *cocoa* is the pure cocoa mixed with water, and hardened in cakes, but without the additional ingredients generally used in chocolate. The purest cocoa is obtained by removing the shell of the bean, and using the interior portions only.

Cocoa or chocolate is used in different ways. Sometimes the cake is eaten in a solid state, as a nutritious article of diet; sometimes it is scraped into powder, and mixed with boiling water or boiling milk, when it makes a beverage somewhat thick, but agreeable to the palate; and sometimes the unmixed and pure cocoa is boiled in water, with which it forms a dark brown decoction. With sugar and milk this makes an agreeable drink, better than the ordinary chocolate for persons of weak constitutions.

Cocoa is said to produce exhilarating and soothing effects, like tea and coffee, and, like them, to diminish the ordinary waste of the system. But it is remarkably distinguished from tea and coffee by containing a large proportion of oily matter, known as cocoa-butter, which amounts to more than half the weight of the shelled or husked bean. Hence it is a very rich article of food; and for this reason it not unfrequently disagrees with delicate stomachs. It also contains a considerable proportion of starch and gluten—substances which form the leading constituents of all the more valuable varieties of vegetable food. The botanist Linnæus was so fond of cocoa that he gave to the tree the generic name of *Theobroma*, a compound Greek word which means "food of the gods."

The total annual consumption of cocoa is estimated at one hundred millions of pounds; and it is believed to be in general use as a beverage among fifty millions of mankind.

Chiccory (*Cicho'rium inty'bus*, Lin. S., xvii., 1; Nat. M., Ang. Exog., ord. *Composite* plants), also called *Succory* and *Endive*, is a wild weed found growing abundantly in most countries of Europe, where it is also often cultivated. It has been introduced into this country, and is cultivated in Westchester County, near New York, and in some other places. In a wild state the stem, which is round and rough, grows from one to three feet high; but when cultivated, it shoots up five or six feet: flowers sessile, bright blue, large and showy, with the corollas flat and five-toothed; the upper leaves cordate and acuminate; but the lower ones have that peculiar form called *runcinate*, as shown on the Chart. A *runcinate* leaf is one that is pinnatifid (see page 181), and that has the segments pointed and curved *backward*. The root of this plant, which is large, white, or brownish, parsnip-shaped, and which increases in size when the plant is subjected to cultivation, abounds in a bitter juice, which has led to its use as a substitute for coffee; and for this purpose the plant is extensively cultivated in Prussia, Belgium, and France. The root is taken up before the plant shoots into flower, is washed, sliced, and dried; a little lard is then put in, and the root is roasted until it is of a chocolate color, after which it is ground, and packed in papers for use. When steeped in hot water it imparts to the water a dark color, and a sweetish-bitter taste; but it has not the pleasant odor and flavor of genuine coffee. To many it is not only disagreeable to the taste, but nauseous in a high degree; yet others become very fond of it, and it is probable that its bitter principle possesses a tonic or strengthening property. It is said, however, that "prolonged and frequent use of it produces heartburn, cramp, and acidity in the stomach, loss of appetite, weakness of the limbs, tremblings, sleeplessness, a drunken cloudiness of the senses, etc., etc."

Chiccory is used very largely to adulterate ground coffee, as it is found that a little of the roasted chiccory gives as dark a color to water, and as bitter a taste, as a great deal of coffee. As evidence of the extent to which it is used,

English statistics show that, in the year 1845, 2000 *tons* of chiccory were imported into Great Britain alone from the Continent, and it is known that since that period its use has greatly increased. The presence of chiccory in ground coffee may be detected by putting the coffee into cold water, as chiccory will impart a brownish-yellow color to the water, which pure coffee does not. Those who would guard against such imposition should buy the coffee in the kernel, and grind it themselves.

The HOP (*Hu'mulus lu'pulus*, Lin. S., xx., 5; Nat. M., Ang. Exog., ord. *Hempworts*) is a perennial plant, with an annual stem, rough, and twining with the sun, found wild in hedges, and extensively cultivated both in Europe and in this country for its flowers or scaly aments, which are used in the manufacture of beer. This plant, like all others of the twentieth Linnæan class, bears its pistillate and staminate flowers on different individuals; and it is the female or pistillate plant, therefore, containing the seeds or fruit, that is chiefly cultivated. The leaves are very rough, generally three-lobed, deeply cordate at the base, and on long petioles. For the shape of the flowers of both kinds, see the Chart. The scales of the fertile flower, when arrived at maturity, are covered with yellowish resinous atoms, forming a fine powder, which is distinguished by the name of *lupulin*. It is this powder chiefly which contains the bitter, tonic, narcotic, and aromatic properties which render the plant valuable. A tea made of hop flowers is not only tonic, but it soothes also and tranquillizes, allays pain, reduces the pulse, and in a slight degree induces sleep. The chief use of the hop in brewing is to prevent the beer from becoming sour, and this it does by checking the fermentation before all the sugar becomes converted into alcohol. It also imparts to the beer its own peculiar narcotic and tonic properties.

Between fifty and sixty thousand acres are devoted to the raising of hops in England alone; and the people of Great Britain consume about forty millions of pounds of hops annually. England consumes more hops than all the

world besides; and it is therefore very evident that the English people are the greatest beer-drinkers in the world.

From two to three millions of pounds of hops are now raised annually in this country—two thirds of this quantity being produced in the State of New York. In the year 1850 the breweries of this state produced 645,000 barrels of ale.

Numerous bitter plants have been recommended and occasionally used in beer, to replace or supplant the hop—such as horehound, wormwood, gentian, quassia, chamomile, fern leaves, broom tops, ground-ivy, dandelion, chiccory, and even that most deadly of poisons, *strychnine.* Strychnine is an intensely bitter substance contained in the seeds of the *nux vomica,* a tree growing in various places in the East Indies, and producing a fruit similar to the apple. Loudon, speaking of the seeds of the nux vomica, says, "They are employed in the distillation of country spirits, to render them more intoxicating." The introduction of these seeds in English breweries is prohibited under heavy penalties; but it is believed that they are used, nevertheless. Strychnine is so intensely bitter that its taste can be detected when dissolved in 600,000 times its weight of water. Beer, wine, and brandy drinkers little know the many poisons which are smuggled into their systems under the guise of "beverages."

VII. Plants used for Manufactures.

Herbaceous COTTON (*Gossyp'ium herba'ceum,* Lin. S., xv., 13; Nat. M., Ang. Exog., ord. *Mallowworts*), the kind mostly cultivated in the United States, is an annual, which grows from two to five feet high, with dark green, blue-veined leaves on long petioles, the lower leaves being five-lobed, and the upper often but three. The flower is handsome, about three inches broad, of a pale yellow color, with one pistil, and five petals, which are purplish at the base. On the falling of the flower, a pod of triangular shape, about the size of a small walnut, is developed. This pod or capsule enlarges, and in course of ripening bursts, disclosing a snow-white or yellowish ball of down in three

locks, inclosing and tightly adhering to the seeds, which resemble those of the grape, though of several times the size. The cotton is, therefore, this vegetable down, which consists of beautifully fine fibres, of exquisite softness. The cotton fibre, however, when examined by the microscope, is found to have two sharp sides, to which are ascribed the irritation and inflammation of wounds and ulcers when dressed with cotton instead of lint.

Some ten species of cotton are enumerated by botanists; but of these there are only three really different kinds—the herbaceous, shrub-cotton, and tree-cotton. Varieties of these three are numerous. Thus an important variety of the herbaceous is the exquisitely fine, long, and strong-stapled *sea-island* cotton, which is produced only on the low sandy islands along the coast of South Carolina and Georgia.

The cotton-seed is planted in the spring—in the Carolinas and Georgia about the beginning of April—in rows five or six feet apart, the distance between the holes in which the seeds are deposited being about eighteen inches. Much care in weeding, thinning, and pruning is required during the process of culture. A field of cotton at the gathering, when the globes of snowy wool are seen among the glossy dark leaves, is singularly beautiful. The cotton-bolls begin to open about the middle of July, and continue opening until the appearance of frost, from the middle to the end of October. The *picking* is done by hand; after which the cotton is passed through a *cotton-gin* machine to free it from the seeds. It is then packed in large bales or bags for the market, by the aid, generally, of cotton presses. The weight of the bale, however, is by no means uniform, varying in different countries, and in different sections of the same country, at different periods, and according to the different kinds or qualities of the article. In the year 1855 a reliable publication gave the average of the Virginia, Carolina, Georgia, and West India bale at from 300 to 310 pounds; that of New Orleans and Alabama at from 400 to 500 pounds; Brazilian at from 160 to 200 pounds; and Egyptian at from 180 to 280 pounds.

The value of the annual cotton crop in the United States is about 150 millions of dollars; and, indeed, the main dependence of the world has hitherto been on this country, which, in the year 1857, furnished 3,500,000 bales out of a total product of 4,200,000. The price of American cotton per pound during the ten years ending with 1855, averaged a fraction over nine cents, the highest average for any one entire year being 12.11, and the lowest 6.4.

The manufacture of cloth from cotton had its origin, at a very early period, in Southern and Western Asia, where the cotton-plant is indigenous, and where the climate renders a light and absorbent fabric a suitable clothing for the people. Throughout the southern half of Asia and portions of Africa the clothing of the people is almost exclusively of cotton. The cotton manufacture of China is of immense amount, but it is carried on almost entirely for home consumption. It is only about three hundred years since the manufacture of cotton was first attempted in Europe, and then it was chiefly by tedious hand-labor; but in place of the one-thread wheel then used for spinning, and each requiring the labor of one person, we now sometimes see seventy or a hundred thousand spindles whirling away in one building, the whole driven by machinery, and requiring the attention of perhaps not a dozen persons.

The *names* given to the various kinds of cotton-goods are almost innumerable. The following may be given as some of the principal groupings. 1st. *Ginghams*, which consist of stout cotton, in which threads of two or more colors are woven together into stripes; 2d. *Fustians*, *beaverteens*, *velveteens*, *moleskins*, etc., which are woven on the same principle as velvet, with a nap or pile, which is either cut or left uncut; 3d. *Damasks*, *huckabacks*, *diapers*, *ticks*, and *cambrics*, which are cotton imitations of the similarly-named flaxen goods; 4th. *Quilts* and *counterpanes*, which have downy tufts to increase the thickness and softness; 5th. Shirting, sheeting, and printing calicoes, etc., which are varieties of plain, serviceable cotton goods, varying in stoutness; 6th. *Chintz*, which is a stout calico, afterward

printed in several colors; 7th. *Corduroys, jeans, quiltings*, etc., which are very strong cotton goods, mostly twilled; 8th. *Muslins*, of which there are almost innumerable varieties, such as book-muslins, jaconet, bishop lawn, tarlatan, Scotch lawn, Victoria, India and Swiss, leno, striped, lappet, sprig-muslins, etc., etc., etc.

The foregoing will, we trust, give some little idea, at least, of the vast importance to mankind of the famous *Cotton Plant*, which we have represented on the Chart.

The HEMP (*Can'nabis sati'va*, Lin. S., xx., 5; Nat. M., Ang. Exog., order *Hempworts*) is an annual plant, growing ordinarily from six to eight feet high, springing up spontaneously in hedges and waste grounds; stem pilose (with erect thin hairs); leaves palmate, lower ones from five to seven-leafed, with the leaflets lanceolate, serrate, from three to five inches long, and one fifth as wide, the middle one the largest; flowers small, green, solitary, and axillary in the staminate plants, but in spikes in the pistillate plants. (The male and female flowers in the 20th class are always on different plants.)

The hemp plant is extensively cultivated in Central Asia, in many countries of Europe, particularly Russia and Poland, and in different parts of North America, for its fibrous covering or bark, which is used in the manufacture of coarse and stout cloths, canvas, cordage, etc. It is said that more than 180,000 pounds of rough hemp are used in the cordage of a first-rate man-of-war, including rigging and sails. In the year 1850 35,000 tons of hemp were raised in the United States—the larger portion in Kentucky and Missouri.*

But the common hemp has also been used among East-

* What is called *Manilla*, or Manilla hemp, from which the stoutest of cordage is made, consists of the fibre of a species of wild banana, which grows in vast abundance in the Philippines and Spice Islands.

What is known as *gunny* cloth, or *gunny* bags—the bags or sacks in which nearly all the rice, paddy, wheat, sugar, pepper, coffee, etc., are exported from the East Indies—is made of the fibre of two plants which are extensively cultivated in Bengal. It is often called *Indian hemp*, but is a plant totally different from the common hemp.

ern nations, almost from time immemorial, as a *beverage*, for its *narcotic* virtues. Its narcotic properties reside in a resinous substance which is contained in the sap. In cold countries very little of this resinous substance is found in the plant; but in warm countries it is so abundant as to exude naturally from the flowers, twigs, and young leaves. What is also singular, the fibre of the plant is worthless in warm climates. Among the Turks and Arabs, and generally throughout Syria and Egypt, the preparations of hemp in common use are known by the name of *hashish*, and it is prepared in various forms for smoking, chewing, and drinking. When taken in moderation this narcotic produces increase of appetite and great mental cheerfulness; but in excess it causes a peculiar kind of delirium and catalepsy—the latter being a kind of spasmodic disease, in which there is a sudden suspension of the action of the senses and of volition, while the heart continues to pulsate. A physician in India has given the following account of one of his experiments with an Indian patient:

"At two P.M. a grain of the resin of hemp was given to a rheumatic patient; at four P.M. he was very talkative, sang, called loudly for an extra supply of food, and declared himself in perfect health. At six P.M. he was asleep. At eight P.M. he was found insensible, but breathing with perfect regularity. His pulse and skin were natural, and the pupils freely contracted on the approach of light. Happening by chance to lift up the patient's arm, the professional reader will judge of my astonishment when I found it remained in the posture in which I placed it. It required but a very brief examination of the limbs to find that, by the influence of this narcotic, the patient had been thrown into the strangest and most extraordinary of all nervous conditions, which so few have seen, and the existence of which so many still discredit—the genuine catalepsy of the nosologist. We raised him to a sitting posture, and placed his arms and limbs in every imaginable attitude. A waxen figure could not be more pliant or more stationary in each position, no matter how contrary to the natural influence

of gravity! To all impressions he was, meanwhile, almost insensible." After a time, as it appears, the effects of the narcotic passed off entirely, leaving the patient apparently uninjured.

COMMON FLAX (*Li'num usitatis'simum*, Lin. S., v., 5; Nat. M., Ang. Exog., ord. *Flaxworts*) is an important plant, that has been cultivated from the earliest ages in some European countries; its bark of strong fibres being manufactured, and its seed crushed for oil. Flax is an annual, and was introduced into this country from England. It has a stem from one to two feet high, branching above; leaves alternate, three-veined, linear-lanceolate, and acute; flowers blue, having the sepals of the calyx, the petals, the stamens, and generally the styles, five in number.

The flax is gathered by pulling it up by the roots when the seeds (contained in round bolls about the size of a pea) are ripe; the seeds are next thrashed out, after which the fibrous is separated from the woody portion, sometimes by spreading the plants upon the grass and leaving them there until the woody portions become rotten, when they are broken up and removed by an instrument called a brake, and sometimes by steeping the stems in hot water, and then applying the brake. The long unbroken fibres are next thoroughly *hatcheled*, to remove the coarse portions of the fibre called the *tow*, after which the flax is ready for spinning, preparatory to its being woven into cloth. The cloth is called *linen*, from the Celtic word *llin*, a thread, the Greek word *linon*, and the Latin *linum*. Hence the oil from the seed is called *linseed* oil—an oil used extensively in mixing paints, printer's ink, etc.

Flax is largely manufactured into cloth in England, more than a million hundred weight of it being imported into England annually to be made into cloth in English factories. In the year 1850, 562,000 bushels of flax-seed were raised in the United States, and nearly 8,000,000 pounds of flax. Yet this only partially supplies the demand, for we annually import linen thread and linen cloth to the amount of six or eight millions of dollars.

The White Mulberry (*Mo'rus al'ba*, Lin. S., xix., 4; Nat. M., Ang. Exog., ord. *Morads*), noted as being the tree on whose leaves the *silk-worm* best likes to feed, is usually cultivated wherever the silk-worm is reared. It is a tree, sometimes growing to a height of thirty or forty feet, with a trunk from ten to twenty inches in diameter, although when cultivated it is usually kept down as a shrub, for the greater convenience of gathering the leaves. It is readily distinguished from the black mulberry, even in winter, by its more numerous, slender, upright-growing, and white-barked shoots. The leaves are from two to four inches long, acute, generally cordate and entire, but sometimes lobed, and always deeply serrated. The flowers, which put forth in May, are green, in small roundish spikes or heads, and are succeeded by an abundance of *white* fruit when the tree is in its native state; but cultivation has produced numerous varieties in the color of the fruit, such as ash-colored, purple, and even *black*. The variety called *multicaulis* is black-fruited; so that we have, literally, a "white mulberry" that is *black*.

The leaves of the mulberry abound in a milky juice, which is found to possess more or less of the properties of caoutchouc or India-rubber, according to the climate in which the tree is grown. It is doubtless owing to this property in the leaves of the mulberry that the threads of the silk-worm have more tenacity of fibre than those of any other insect that feeds on the leaves of trees. The leaves gathered from trees growing on a poor and dry soil, and in warm climates, are better for the silk-worms, and produce better silk, than those from a rich soil and cold climate.

The eggs from which the silk-worm is hatched are of a yellowish color (see Chart), about the size of a small pin-head. They are laid by a kind of grayish-colored moth (see Chart), which most persons would doubtless call a butterfly. These eggs are hatched at the season of the year when the mulberry begins to put forth its leaves; and the young are at first small black worms, about the size of a

small ant. Feeding on the tender mulberry leaves, the silk-worm grows rapidly, and comes to maturity in about four weeks. When from two to three inches long it is of a milky or pearl color, or blackish; these latter are esteemed the best. Its body is divided into seven rings, to each of which are joined two very short feet. One of these silk-worms, of the natural size, is represented on the Chart as feeding on a mulberry leaf. When arrived at maturity, the silk-worm stops eating; it begins to diminish in length, and to increase in thickness, and soon proceeds to inclose itself in an oval-shaped yellowish ball or *cocoon*, which is formed of an exceedingly slender and long thread of fine yellow silk. This silky cocoon is the silk-worm's shroud, which it proceeds to put on preparatory to its burial. The silk is formed in the stomach in two little masses, and is spun from a small point, like a little thorn, near the extremity of its body.

By the time the cocoon is finished, the silk-worm has become transformed into an oblong roundish ball, and it then appears to be perfectly dead. This is called its *chrysalis* or *pupa* state. Three of these *chrysali* are represented on the Chart, of the natural size. Many animals may often be seen in this state, and somewhat resembling a bean, adhering to old boards, the outsides of houses, etc. The worm remains in its chrysalis state, shut up in the cocoon, several days, perfectly motionless, and seemingly dead; after which the cocoon bursts, like an egg hatching, and what was the silk-worm comes forth a dull-looking moth, with wings, such as we first described; but these wings it never uses for flying, and it only crawls slowly about in the place where it was hatched. In this, the last stage of its existence, the insect tastes no food, but in a few days the female lays from 300 to 500 eggs, and then dies. And this completes its "strange eventful history."

In order to preserve the silk, the moth is killed in the cocoon, and not allowed to come forth, otherwise the threads of silk would be broken. What is called *raw* silk is produced by winding off, at the same time, on a com-

mon reel, the threads of several of the balls or cocoons. Without the *mulberry* for the silk-worm to feed upon, no silk of any value would be produced.

The silk-worm is reared very extensively in China, from which country there are annually exported to England alone from two to four millions of pounds of silk. The worms are also reared throughout the British East Indies, Turkey, Greece, Sardinia, Italy, France, etc.; and some attention has been paid to the silk culture in the United States. The total value of the annual production of silk in the world is estimated at *two hundred millions of dollars!* Surely the little worm that creates all this value is not to be despised; and it is very plain that the *tree* on which it feeds is, next to the worm itself, an article of vast importance to mankind. How many of the "gay belles of fashion" ever reflect, as they exult in their silken finery, that they are decked in the *shroud* which a *worm* wove for its own burial!

VIII. Miscellaneous.

TOBACCO (*Nicotia'na taba'cum*, Lin. S., v., 1; Nat. M., Ang. Exog., ord. *Nightshades*) is a plant found growing wild in North America, but which succeeds well, and is extensively cultivated in most parts of the Old World. It belongs to the order of *Nightshades*, in which are found those virulent medicinal poisons, nightshade or belladonna, henbane, and stramonium.

Tobacco is an annual plant, growing from four to six feet high, with stem and branches viscid or glutinous, and downy; leaves from one to two feet long, lanceolate, sessile, and decurrent or partially clasping; corolla pink, funnel-shaped, having the mouth inflated, and five-lobed; and it has five stamens and one pistil.

The fresh leaves of tobacco possess very little odor or taste; but when dried their odor is strong, narcotic, and somewhat fetid; their taste bitter, and extremely acrid. When well cured, they are of a yellowish-green color. When distilled, they yield an oil, on which their virtue de-

pends, and which is a virulent poison. The leaves are used in various ways, being chewed, smoked, and ground and manufactured into snuff.*

According to the census returns for the year 1850, the whole number of acres devoted to the cultivation of tobacco in the United States was *four hundred thousand;* product, at six hundred pounds to the acre, 240 million pounds; estimated value, fourteen millions of dollars; number of tobacconists and cigar-makers in the United States, 10,823. Virginia is the greatest tobacco-growing state, next to which is Missouri.

British writers state that about twenty-six thousand *tons* of tobacco are annually consumed in Great Britain and Ireland, and that more than half of this quantity is smuggled into the country, on account of the excessive duties (upward of 1000 per cent.) levied on the article. These duties amounted, during the year ending January 5th, 1853, to nearly twenty-three millions of dollars. The revenue which the French government derived from the tobacco imported into France during the first nine months of the year 1857 amounted to more than twenty-five millions of dollars! The United States supplies about two fifths of all the tobacco consumed in Europe.

It is said that tobacco is, next to salt, probably the article most universally consumed by man. In one form or other, but most generally in the form of fume or smoke, there is no climate in which it is not consumed, and no nationality that has not adopted it. To put down its use has equally baffled legislators and moralists; and, in the words of Pope on a higher subject, it may be said to be partaken of "by saint, by savage, and by sage." A German writer has preserved the titles of a hundred volumes

* The late Col. Stone, editor of the Commercial Advertiser of New York city, in one of his lectures against the use of tobacco, describes a *sign* which was placed upon a store occupied by three brothers, dealers in tobacco. It read as follows:

"We three, brothers be, in the same cause;
Jim snuffs, Jo puffs, and I chaws."

which have been written against the use of tobacco. Among these books is that of James Stuart, King of England, who describes the smoking of tobacco as "a custom loathsome to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs, and in the black stinking fume thereof nearest resembling the horrible Stygian smoke of the pit that is bottomless."

Medical writers have generally condemned the use of tobacco in the strongest language; and, as Professor Johnston says, "It is remarkable how very few persons can state distinctly why they began, and for what reason they continue the indulgence." The botanist Lindley thus describes the properties and effects of tobacco: "It is a powerful stimulant narcotic, employed medicinally as a sedative, and in vapor to bring on nausea and fainting. When chewed, it appears to impair the appetite, and induce torpor of the gastric nerves. Although, if smoked in moderate quantities, it acts as a harmless excitant and sedative, yet it is a frequent cause of paralysis when the practice is indulged in to excess. Oil of tobacco, which is inhaled and swallowed in the process of smoking, is one of the most violent of known poisons. The Hottentots are said to kill snakes by putting a drop of it on their tongues; and the death of these reptiles is said to take place as instantaneously as if by an electric shock."

There is very little doubt, when we consider the enormous extent to which tobacco is used throughout the world, that it actually produces more disease, suffering, and death than ardent spirits themselves. Such is the testimony of eminent medical men and physiologists.

COC'CULUS IN'DICUS (*Anamir'ta cer'rulus*, or *Menisper'mum cer'rulus*, Lin. S., xx., 10; Ang. Exog., ord. *Menispermads*) is a twining East Indian plant, a narcotic poison, with large, orbicular, and sub-cordate leaves; flowers green and yellow, producing clusters of berries like grapes, but smaller, first white, then red, and finally blackish-purple. In the East Indies these berries are made up into a paste, and used to intoxicate fish, birds, and different sorts of

vermin; but in *civilized* countries they are largely used to adulterate ale and beer, and to poison and intoxicate *men and women.* Professor Johnston says: "The bruised seeds of this plant impart to beer an intensely bitter taste, and can thus be substituted cheaply for about one third of the usual quantity of hops, without materially affecting the flavor of the beer. They give a fullness and richness in the mouth, and a darkness to weak and inferior liquors. In these respects a pound of Cocculus indicus is said to be equivalent to four bushels of malt; hence disreputable brewers are tempted to use it largely." The English government has imposed a heavy penalty upon brewers who use it, and upon druggists who sell it to them; but yet an extract from this poison, called *Pereira,* is extensively employed in the breweries of England, and probably in those of this country; and writers on brewing give plain directions for using the drug. Such facts should be a caution to ale and beer drinkers.

VANILLA (*Vanilla aromat'ica,* and also *Vanilla planifolia,* Lin. S., xviii., 1; Nat. M., Agl. End., ord. *Orchids*), which furnishes one of the most delightful of aromatics known, is a species of vine, extensively cultivated in Mexico, and in some countries of South America. It rises to the height of eighteen or twenty feet, shoots out roots at every joint, like the ivy, by which it clings to the bark of trees; its leaves are ovate-oblong; flowers of a greenish-yellow color, surrounded by the long and wavy sepals of the calyx; fruit a pulpy pod, eight or ten inches long and scarce an inch broad, of a yellow color when gathered, but changing to a dark brown or black. This fruit is wrinkled on the outside, and full of a vast number of seeds, like grains of sand, having a peculiar and delicious fragrance. Not only these seeds, but the pods also, when properly prepared, are used in the manufacture of chocolate, and in various drinks, ice-creams, candies, etc., etc., to give them an agreeable flavor. The pod, when ripe, is said to yield from two to six drops of a liquid, which has an exquisite odor, and which is known as balsam of vanilla. This bal-

sam, however, is seldom seen. The dried pods constitute most of the vanilla of commerce. The amount of vanilla imported into and consumed in this country is believed to exceed 5000 pounds per annum, valued at from $20 to $30 a pound.

The VARNISH-TREE (*Melanorrhœ'a usita'ta*, Lin. S., xx., 1; Nat. M., Ang. Exog., ord. *Anacards* or *Terebinths*) is introduced on the Chart as the representative of a class of trees and shrubs having a resinous, gummy, caustic, or milky juice, often poisonous, and from some of which an excellent varnish is obtained, much used by Eastern nations. Among these varnish-trees are the Cashew-nut, the Marking Nut-tree, the Semecarpus, the tree from which the Japan lacquer is obtained, several trees which produce the copal varnish, and the one we have represented on the Chart, called, by way of distinction, *the* Varnish-tree. This is a large tree, a native of Hindostan, China, etc., having blunt, obovate leaves, in whorls of six, and deep red flowers. The varnish-drug is the *sap* of the tree, and it is used extensively for painting river craft, and for varnishing vessels destined to contain liquids. Among some of the Eastern nations, every article of household furniture destined to contain solid or liquid food is lacquered over with it. The drug is also used as a glue-sizing in the process of gilding; the Burmans use great quantities of it in gilding their idols, and also for their religious writing upon ivory, palm-leaves, and metals.

FISH-POISON (*Tephro'sia toxica'ria*, Lin. S., xvi., 4; Nat. M., Ang. Exod., ord. *Leguminous* plants) is introduced on the Chart as the representative of quite a number of plants which are used, in different countries, for stupefying fish. The plant here represented is nearly allied to the Indigo plant, and is cultivated in some of the West India islands. It is also found growing wild in South America. It is about three feet high, with oblong-lanceolate, blunt, and ash-colored leaves; purple flowers, in a long terminal raceme; pods long, round, and spreading from the stalk. The leaves, branches, and pods, well pounded, and thrown

into a river or pond, very soon affect the water and intoxicate the fish, so as to cause them to float on the water as if dead. Most of the large fish recover after a short time, but nearly all the small ones perish.

The Cocculus indicus is used for the same purpose, also the Brazilian Phyllanthus, Angostura and Cinchona bark, the Chaubnoogra of the Hindoos, the evergreen Took or Hydrocarpus, and many other plants.

IX. Plants used for Coloring.

The INDIGO PLANT (*Indigo'fera tincto'ria*, Lin. S., xvi., 4; Nat. M., Ang. Exog., ord. *Leguminous* plants) is extensively cultivated in the East Indies for the drug which yields the beautiful blue dye known by the name of *indigo*. It has a woody stem, from three to six feet high; leaves pinnate and oblong; flowers purple, and papilionaceous or butterfly-shaped; the fruit a long, round, curving pod, containing the seeds or beans.

The indigo is obtained by cutting the plant before it comes into flower, and thoroughly steeping it in water until it has parted with its coloring matter, which, when drained off, is found to be a thick substance; and this dries, and becomes hard on exposure to the air. It is an article in very general use, and is found in most country stores.

A species of the indigo plant is also cultivated in Central America and Venezuela; and it may be raised without difficulty in the southern United States. The consumption of indigo in England amounts to about two million pounds per year, most of it obtained from the East Indies. The United States use about three quarters of that amount. The ordinary kinds may be bought for about 75 cents per pound, but the best indigo is usually worth two dollars per pound.

Before indigo came into use in Europe, the blue coloring matter used was obtained from a plant called *woad*, which was extensively cultivated. The ancient Britons and Picts colored themselves with the juice of the woad. Indigo is

almost the only dye-stuff now used for giving a blue color to cloth; yet several plants yield it in small quantities besides the one we have described. A blue is sometimes given to silk by means of verdigris and logwood, but it possesses little durability.

SAFFRON.—The substance called *saffron* consists of the dried *stigmas* of the Fall Crocus (*Cro'cus sati'vus*, Lin. S., iii., 2; Nat. M., Agl. End., ord. *Irids*), which is a well-known perennial, bulbous plant, of the Iris order. The Fall Crocus grows about six inches high; leaves radical (starting from the root) and linear; flower with a long, white, slender tube, extending down nearly to the bulb, and having the segments above purple; stigma long, three-cleft, projecting beyond the flower, and of a rich, deep orange-red color, or what is called *saffron*. Saffron, which is one of the richest yellows, is much employed by painters and dyers; it was formerly much used in medicine, and it is now often used to color butter and cheese, sauces, creams, biscuits, conserves, etc. It is a harmless substance, which is more than can be said of most of the coloring matter used in confectionery and in the kitchen.*

LOGWOOD (*Hæmatox'ylon Campechia'num*, Lin. S., x., 1; Nat. M., Ang. Exog., ord. *Leguminous* Plants), which is very extensively used as a dye-wood, is a crooked-stemmed low tree, which grows in great abundance, and attains its highest perfection, in the forests of Campeachy, in the West

* Among other plants used for coloring yellow, we may mention, 1st. DYER'S WEED (*Rese'da luteo'la*), which affords a most beautiful dye for cotton, woolen, mohair, silk, and linen. The yellow color of the paint called Dutch Pink is obtained from this plant. 2d. FUSTIC-WOOD (*Mo'rus tincto'ria*), a species of the mulberry-tree. 3d. CATECHU, a name given to several plants. 4th. ANOTTA, obtained from the berries of *Bix'a orella'na*. 5th. QUERCITRON BARK (*Quer'cus tincto'ria*), the bark of the North American black oak. 6th. DYER'S BROOM (*Genis'ta tincto'ria*). 7th. TURMERIC (*Cur'cuma lon'ga*); and, 8th. CHAMOMILE (*Anthe'mis tincto'ria*), which yields a faint yellow; also a species of Carthamus, often called saffron. The flowers of *Car'thamus tincto'rius* are extensively used by the Chinese, in connection with different acids, to give some of the fine rose, scarlet, purple, and violet colors to their silks. The Carthamus is cultivated in many parts of Europe.

Indies. This tree resembles the white thorn, but is much larger. It has abruptly pinnated leaves, with obcordate leaflets, and yellow flowers on a terminal spike. The inner bark and wood are red; the latter dark, and very red. This wood is imported in logs, which are afterward cut into fine chips; and these chips, which impart their color to water and alcohol, are used for coloring. A section of the stem is represented on the Chart.

Among other plants used for coloring red are the Brazil wood, or Pernambuco wood of commerce (used in making red ink), madder, and camwood, the latter yielding a brilliant red color, but one that is not permanent. Camwood is very much used for staining pine and white wood coffins; and the dark red seen in the English bandana handkerchiefs is produced by it, rendered deeper by sulphate of iron.

(The cochineal used for dyeing crimson, and also some of the scarlet hues of red, consists of small *insects*, of which there are about 70,000 in a pound. This cochineal is a powdery-looking substance, scraped from the leaves of a cactus plant, and so small are some of the insects that it requires the microscope to detect them.)

MADDER (*Ru'bia tincto'rum*, Lin. S., iv., 1; Nat. M., Ang. Exog., ord. *Stellates*, or Star Flowers), a native of the south of Europe, Asia Minor, and India, is a trailing or climbing plant, the root of which is extensively used by clothiers and calico-printers for dyeing the scarlet reds. What is called *Turkey red* is produced by the madder from Turkey. The roots are nearly half an inch in diameter; they strike deep into the ground, and grow to the length of three or four feet. They are dried, and then pounded or ground. What is sold under the names of *mull*, *gameen*, *crops*, and *garance*, is pounded madder.

The madder has an annual, herbaceous, quadrangular stalk, covered with prickles, which give it support in climbing; leaves mostly in whorls of six; flowers yellow; and fruit a double-celled drupe or berry, as represented on the Chart, with a part of the flower at *b*, and the double kernel at *c*.

In the process of dyeing cloths, some substance must generally be used to fix or *set* the color—that is, to make it durable, and prevent it from washing out. Thus, when cotton cloths are to be colored with madder, they are generally steeped or boiled previously in alum water. The substance or preparation which is used to fix the color is called a *mordant*. The principal mordants are alum, tin, tartar, some of the oxides of lead and copper, and nut-galls.

We have thus described, briefly, the plants used in dyeing the three primary colors, red, yellow, and blue. The tints, hues, and shades of these are produced by various mixtures, on the principles explained in the article on colors, page 107, and also by the use of various *mordants*. What is called *brown* proper, however, which has in it a shade of yellow, and is called by the French *fawn* color (*faune*), is obtained without mixtures from several vegetable substances, the principal of which are *sumach*, the peels which constitute the green covering of the nut of the common *walnut*, or shell-bark hickory, the bark of the common *white birch*, and *sandal wood.*

X. Spices.

ALLSPICE, PIMENTO, OR JAMAICA PEPPER, is the fruit of a beautiful tree (*Myr'tus pimen'ta*, Lin. S., x., 1; Nat. M., Ang. Exog., order *Myrtleblooms*), which grows in great abundance on hilly lands on the north side of the island of Jamaica. The tree grows about twenty feet high, with a smooth brown trunk; leaves of a shining green, oblong-lanceolate, and acuminate; flowers fragrant, white, very abundant, and in panicles; berries round, pulpy, purple, becoming reddish-brown or nearly black when ripe. The berries are gathered before they are ripe, when they soon become wrinkled, as they are seen in the shops. They have an agreeable, aromatic, and somewhat astringent taste, resembling that of a mixture of cinnamon, cloves, and nutmegs: hence they have been called "Allspice," from their taste being thought to resemble a composition

of all other spices. The yield of the pimento is abundant, a single tree having been known to produce, in one season, 150 pounds of the raw, or 100 pounds of dried fruit.

During the year 1856 the imports of the pimento into the United States were nearly five millions of pounds, valued at 352,000 dollars. The average price in the market may be set down at fourteen cents per pound.

The buds and berries of the common myrtle (*Myr'tus commu'nis*) were eaten as spices by the ancients, and are still used, instead of pepper, in Tuscany. Among the Myrtleblooms are the pomegranate, cloves, the guava fruits (from which guava jelly is made), the rose-apples of the East, and some very hard-wooded trees, the most famous of which is the *lignum vitæ* of New Zealand.

GINGER is the dried root of a plant (*Zin'ziber officina'le*, Lin. S., i., 1; Nat. M., Agl. End., ord. *Gingerworts*) which is a native of the East Indies and China, but which is now cultivated in great quantities in the West Indies.

The ginger plant has perennial, creeping, tuberous roots, from which arise green, reed-like, annual stalks, about two feet and a half in height, having narrow and lanceolate leaves. The flowering stalk ends in an oblong scaly spike, as represented on the Chart, and from each of these scales a single red or purplish flower is produced.

The roots of ginger are taken up when the stalks fade. The best are then washed with care, scraped, and dried in the sun, and these produce the *white* ginger of commerce; the poorer roots are *scalded* before being dried, and these produce what is called *black* ginger. What is known as preserved ginger consists of the root taken up before it is full grown, scalded, and preserved in sirup. The amount of ginger annually imported into the United States is valued at about 65,000 dollars.

Ginger is used not only as a spice in cooking, but also as a medicine. Dried ginger has a pungent, aromatic odor, and a hot, biting taste. It makes a stimulating drink, useful in colic, debility, and laxity of the system.

(Among the Gingerworts, which are mostly aromatic,

tropical, herbaceous plants, and generally of great beauty, are numerous species used as spices; the warming cardamom seeds of the druggist; grains of Paradise, used to give a pungent flavor to spirituous liquors; several which yield a starch-like arrow-root, and the turmeric used in dyeing yellow.)

The CINNAMON of commerce is the bark of the cinnamon-tree (*Lau'rus cinnamo'mum*, Lin. S., ix., 1; Nat. M., Ang. Exog., ord. *Laurels*), a native of Ceylon, where it grows in abundance, and also of Cochin-China, and perhaps of some other countries. The cinnamon-tree grows to the height of about twenty feet, has a smooth ash-colored bark, a short, erect trunk, and wide-spreading branches; leaves of a bright green above, pale beneath, white-veined, ovate-oblong, and tapering at the apex; flowers green and yellow, in panicles, and inodorous; fruit the size of an olive, soft, insipid, and of a deep blue, inclosing a nut. The *inner* bark, which is taken from branches of two or three years' growth, is considered the best. There are several species of cinnamon from which the bark is obtained. Good cinnamon has an agreeable, warm, aromatic flavor, and a mild, sweetish taste, not so pungent but that it may be borne on the tongue without pain. *Oil of cinnamon* is obtained from the leaves, and *oil of camphor* from the roots. What are called *cassia-buds* are mostly the fleshy receptacles of the seed of the true cinnamon-tree.

(Most of the numerous species of the *Laurel* order are more or less aromatic and fragrant. Our sassafras belongs to the same order. The true *cassia* bark and buds (*Lau'rus cas'sia*) are used for the same purposes as cinnamon; and most of the *camphor* of commerce is obtained, by distillation, from the roots and smaller branches of one of the Laurels (*Lau'rus cam'phora*), usually called *camphor-tree*, although the cinnamon-trees also produce camphor.)

The NUTMEG-TREE (*Myris'tica moscha'ta*, Lin. S., xx., 13; Nat. M., Ang. Exog., ord. *Nutmegs*) is a native of the East Indies, where it is extensively cultivated, especially in the Molucca Islands and Sumatra. It grows to the height

of thirty feet; leaves oblong, acuminate, of a fine green on the upper surface, and gray beneath; flowers small, white, bell-shaped, and without any *calyx*;* the fruit a smooth, fleshy, reddish berry, about the size of a small peach, but more pointed at both ends.

The outer pulpy part of the fruit is nearly half an inch thick; but this dries up when ripe, and forms a coriaceous (leather-like) crust, which opens and discovers a second covering, of a fine reddish-yellow, somewhat like the thin skin of an orange. This second covering or skin, which is taken off by itself, and used as a spice, is what is commonly called *Mace*. It has a pleasant aromatic smell, and a warm, bitterish, pungent taste. Within this covering of mace is a nut, having a hard black shell, and containing a round, heavy, brightish-gray kernel, which is the nutmeg of commerce.

There are several varieties of the nutmeg-tree, but that denominated the green nutmeg, which bears a small round nut, is the best. During the year ending June 30th, 1856, there were imported into the United States about 600,000 pounds of nutmegs, valued at 326,000 dollars. During the same year there were imported about 45,000 pounds of mace, valued at 24,000 dollars.

The nutmeg can be used safely in small quantities only. In excess it produces oppression of the chest, intense thirst, headache, and even delirium and fatal apoplexy.

The Clove-tree (*Caryophyl'lus aromat'icus*, Lin. S., xi., 1; Nat. M., Ang. Exog., ord. *Myrtleblooms*) is a native of the Molucca Islands, where it has been produced in great abundance from the earliest known records. It is now cultivated to some extent in the West Indies.

The clove is a handsome tree, about twenty feet in height, with leaves nearly resembling those of the laurel. First the elongated greenish-yellow flower-buds, which are the calyx of the flower, appear; then from their extremity the corolla shoots forth, of a delicate peach-blossom color.

* Some botanists consider that the nutmeg has a white calyx, and no corolla.

When the corolla begins to fade, the calyx turns first yellow and then red. At this latter stage the calyx buds are beaten from the tree, and, after being dried in the sun, are what are known as the *cloves* of commerce. If allowed to remain on the tree too long, the pungent properties of the clove are in great part dissipated. The average produce of a clove-tree is about two pounds of dried cloves per annum.

Good cloves, which should be large-sized, perfect in all parts, and of a dark brown color, approaching to black, have a strong, fragrant, aromatic odor, and a hot, acrid, aromatic taste, which is very permanent. For culinary purposes, the uses of cloves are almost innumerable. *Oil of cloves*, which is obtained from cloves by distillation, is extremely hot and fiery, and of a pale reddish-brown color.

As cloves readily absorb moisture, and are sold by the ounce or pound, it is said that some merchants keep a quantity beside a vessel of water, by which means a considerable addition is made to their weight.

Other Spices.

Black Pepper, a very common spice, is the fruit of a climbing plant (*Pi'per ni'grum*) which is extensively cultivated in the East India islands. It considerably resembles the grape-vine, with leaves somewhat like those of the ivy. It bears spikes of green flowers, which are followed by red berries. These, when gathered and dried, become deep brown or black, and are the black pepper of commerce. There are about eighty species of the pepper genus. About seven millions of pounds of black pepper are imported into the United States annually.

White Pepper is made by blanching the finer grains of the common black pepper, and gently rubbing them, so as to remove the dark outer coat. It is much prized by the Chinese, but is seldom seen here.

Cayenne Pepper is the produce of several varieties of *Cap'sicum*, an annual plant, a native of both the Indies, producing either a pendulous oblong or globose fruit, one

species of which is common in our gardens, and is usually known as RED PEPPER (*Cap'sicum an'nuum*). The best of Cayenne pepper is the *Cap'sicum bacca'tum*, or *Bird* pepper. The Cayenne seen on our tables is the pod, dried, and reduced to powder. Cayenne pepper has an aromatic, extremely pungent, acrimonious taste, setting the mouth, as it were, on fire, and leaving the impression long on the palate.

Red pepper is much used in a green state for pickling, and, when ripe, for mixing with other ingredients, as tomatoes, etc., to form sauces. It is also dried and ground, and used like Cayenne pepper. The annual production of black, white, and Cayenne pepper, in the East Indies, is about fifty millions of pounds.

Among garden herbs often used as spices for cakes, and in various other kinds of cookery, are the seeds of anise, caraway, coriander, dill, fennel, lavender, and the leaves and seeds of sage, summer savory, sweet marjorum, thyme, etc. The pupils should tell what they know of these, and bring in specimens, that all may learn to recognize them.

We have thus glanced at *a few* of the ECONOMICAL USES of plants; and yet, in our brief survey, we have found that plants furnish us, directly, with most of our food—with our cereal grains, bread-fruits, and other fruits, innumerable in kind and quality; with our tea, and coffee, and cocoa, and chocolate; with numerous other drinks to soothe, to stimulate, to intoxicate; with sugar, and spices, and colors, and medicines, and poisons; with gums, and varnishes, and balsams; with oils, and butter, and milk; with wood for buildings, and furniture, and tools, and fuel; and woody fibres for ropes and for clothing.

APPENDIX.

I. AN APPROXIMATE PROGRAMME

FOR A COURSE OF ELEMENTARY INSTRUCTION DURING THE FIRST TEN YEARS OF SCHOOL LIFE.

As the various subjects of instruction introduced in the foregoing pages are treated there in consecutive order, while many of them are necessarily brought forward in the school exercises of any *one* day, week, or term, an explanatory *programme* is needed to set forth clearly, and make available, the plan of instruction contemplated.

Thus, although the six Reading Charts are taken up, in the preceding Manual, in the order of their numbering, and their uses explained, yet, while the pupil has three or four daily exercises in reading, he has, also, exercises in several other studies or departments, such as Counting, Adding, Printing and Drawing, Size and Form, Color, Animals, Plants, etc.; and these require the use of several additional Charts. Hence the daily routine of the schoolroom requires its programme, with suitable directions to the teacher for conducting the exercises, with references not only to the various Charts, but also to the various other aids—natural objects, etc.—needed; and also with references to the sources of the *information* which the teacher may desire to make available. The following programme is designed to meet, in part, these wants, and to lay down a plan of scholastic training, not only from the Charts, and in "Object" teaching proper, but in *all* the subjects that enter into a course of elementary instruction during the first eight or ten years of school life.

And yet this programme professes to be only an *approximation* toward what is needed by the teacher. Every thorough teacher must, indeed, make his own programme; and the following sketch is given to aid him in doing it. We can present the number and names of studies which we think it expedient to be introduced for any particular grade of pupils, together with the general modes of instruction which we think most appropriate; and we can give some of the information which the teacher needs, and make suggestions which we think valuable; but, after all, the teacher must, of himself, carry out the details.

In our "*approximate*" programme we have commenced with the first year of school life, and carried the plan through ten years, dividing each year into two terms. The studies of each term are designed for a particular grade of pupils. We have presented twelve *subjects* for the first term, but have neither designated the daily *order* in which they should be taken up, nor the *time* to be devoted to each. Each teacher must, necessarily, regulate these things according to the wants of the class (or grade), and according to the time which he can devote to it. For convenience of reference, we have attached the *same number* (in heavy type) to the same study throughout the several terms or grades, so that the teacher can easily follow out the entire course of instruction in any one study. To save space, when the course of instruction in any study is similar to the course in any preceding term, the preceding term and study are referred to by the *marginal* number opposite the name of the study.

Although this programme is necessarily arranged on the supposition that pupils are to go through with the whole, consecutively, from the beginning, yet there is no difficulty in adapting the course of instruction in any school to it, or in allowing a class to take it up at any stage, or in any year of advancement. Suppose there are one hundred pupils in a school, and that they are in five different grades of advancement, from mere *beginners*, to those in the fifth year of school life. If the teacher wishes to put those pupils, who are in the fifth year, into this course, let him require the class to go back, and go over the programme in the manner of a review, and thus bring up those subjects only in which the class is deficient, until the class is prepared to advance systematically. The same may be done with each grade of pupils in the school, so that all may soon be pursuing the regular course of the programme. Even here, however, it will probably happen that teachers in different schools will find it expedient to vary the programme in different ways. All should exercise their ingenuity in bringing in suitable exercises *additional* to those we have marked out; but it may also happen that it may be desirable for a class to lag behind the programme in some *one* subject, and to go in advance of it in *another*. The teacher must exercise his best discretion in all such particulars, using the programme as a *guide* by which to form a better if he can, or one better adapted to the circumstances of his school.

It may not, perhaps, be improper to express our views of the results of such a course of elementary training as we have here marked out. It has been our *leading object* to make it *disciplinary;* such as would best conduce to the highest degree of mental, moral, and physical *cul-*

ture; and we honestly believe that, in this important particular, the system here sketched in outline is immeasurably in advance of the common course of instruction in our primary schools. It aims to train all the faculties in their proper order, and to provide them, as far as possible, with the natural means, methods, and materials for *development.* If we succeed in successfully cultivating the perceptive faculties in early life, as is the aim of a *true* "object" system of instruction, we know that, through them, the rudiments of all *knowledge* will be most successfully acquired also; for the very *exercise* of these faculties necessarily stores the mind with *ideas* of objects and events, and of the qualities and relations of things, thus contributing to both mental growth and strength. Discipline and acquisition should, indeed, go hand in hand in any system of instruction; but where discipline is sought by a forced and arbitrary exercise of any faculty—as by memorizing words without meaning, learning *signs* before we have any ideas of the things signified—we do violence to nature, and the mental powers are weakened. *It is by harmonizing mental discipline with mental acquisition, upon the basis of the natural order of development, that we hope for the happiest results to the cause of Education.*

FIRST SCHOOL YEAR.

FIRST TERM.

1. **1. Reading and the Alphabet.**—Calling words at sight, from Chart No. I. See Manual,* p. 26. Also begin Chart No. II., Manual, p. 28. Three or four short lessons daily. Cultivate a natural manner of speaking the words. See, also, for suggestions, Calkins's Primary Object Lessons, p. 278-288. Also Calkins's Manual.

The Alphabet is to be taken up when the pupils can readily call the words at sight on Chart No. I. See Manual, p. 26. Two or more lessons daily. Spelling. See next term.

2. **2. Counting.**—Begin with counting pebbles, beans, etc., from one to thirty. See Calkins's Primary Object Lessons, p. 138–9. Also, make use of the *letters* in the words on Chart No. I. See preceding Manual, p. 26.

3. **3. Printing Letters, and Drawing.**—See Manual, p. 26–7–8. Also Primary Object Lessons, p. 94–5–6. Use slate-pencils or lead-pencils. Chart No. XI. may also be used to copy from.

4. **4. Oral Compositions: Language.**—See Manual, p. 28 and 29. Be careful to correct all faulty language in the pupils. See, also, suggestions in Manual, p. 14 to 18.

* Where "Manual" is referred to, it is the present work. "Calkins's Manual" is referred to by name.

5. **5. Size and Form.**—See Primary Object Lessons, p. 49, 50, 160–162. Use the blocks illustrating the figures on Chart No. XII. Give the names, with but little explanation.

6. **6. Color.** — See Primary Object Lessons, p. 112–114; Chart No. XIII., and through verse 1 of Manual, p. 92. Make use of the Hand Color-cards.

7. **7. Animals.**—Let pupils name all the different kinds (species) of animals which they have seen, describing them, and naming their parts and uses; also let them point out and name all the animals represented on Chart No. I. See, also, Calkins's Manual. Let the teacher tell what he has seen animals do, etc., and thus interest the children in the subject.

8. **8. Plants.**—Let pupils name (and describe as well as they can) all the kinds of trees they know; also kinds of grain, garden vegetables, shrubs, herbs, weeds, etc., bringing in and examining specimens of as many different kinds of leaves and flowers as they can, describing the forms of their *roots*, etc. Also point out the similar forms of leaves, flowers, roots, etc., on Chart No. XIX. See, also, Calkins's Manual.

9. **9. Physical Exercises** every half hour. *Human Body*, etc. See Primary Object Lessons, p. 186–188, 190–192, and 229. We would enjoin upon trustees, directors, etc., the importance of having pleasant and inclosed play-grounds.*

10. **10. Manners and Morals.**—Pupils, at this stage, should be *told* simple stories, incidents, etc., illustrating principles in Manners and Morals. Some excellent ones, with suggestions, etc., may be found in "Cowdery's Moral Lessons." Do not *read* the stories to them.

11. **11. Miscellaneous Objects**—designed to carry out a system of familiar "Object" teaching. See Calkins's Primary Object Lessons, p. 26 to 35.

12. **12. Construction.**—See suggestions on this subject, p. 54 of Manual. Give children several pairs of straight sticks, and let them lay them on the tables, *two by two*, in as many different positions as possible. Then let them draw the same positions on the blackboard. Arrange *three sticks* and *three straight lines* in a similar manner. Also provide them with a large number of small wooden blocks, like bricks, of uniform size, and let them build walls, pillars, buildings, etc., with them.

Music should be introduced two or three times each day, if the teacher can sing, or if several of the older pupils can lead the others in singing.

* Great attention should be given, *from the beginning*, to the cultivation of a *habit* of erectness of form and position. While sitting at the desk, using the pencil or pen, etc., keep the body erect.

SECOND TERM.

13. 1. READING, THE ALPHABET, AND **Spelling.**—Same as first term, and continued through Chart No. II. See, also, Manual, p. 28, 30, 31, and 32. When pupils can call the words readily at sight, they may go over what they can thus read in *concert exercises* once a day. Be very careful, however, to have them repeat the words in a free and natural manner. *Spelling.* First introduced. Spell orally, and also with Type Letter-cards. See Manual, p. 29.

14. 2. COUNTING.—Continue as before directed. See, also, Primary Object Lessons, p. 139–146. Preceding Manual, p. 30, 31, 32.

15. 3. PRINTING LETTERS, AND DRAWING.—Same as before. See, also, Manual, p. 29, 30, 31. Charts X. and XI. Primary Object Lessons, p. 96, 97.

16. 4. ORAL COMPOSITIONS, LANGUAGE.—Same as before. See, also, Manual, p. 28, 30, 31, and 32. Be careful to correct all ungrammatical expressions of the pupils.

17. 5. SIZE AND FORM.—Same as in preceding term. Also Primary Object Lessons, p. 50–54.

18. 6. COLOR.—Same as preceding term.

19. 7. ANIMALS.—Same as in the preceding term; and, in addition, let pupils point out and name all the animals represented on the upper part of Chart XV. Anecdotes of the kinds of animals mentioned. See Calkins's Manual: Programme, etc.

20. 8. PLANTS.—Continue the course of the exercises marked out for the preceding term.

21. 9. PHYSICAL EXERCISES.—See preceding term. Also Calkins's Primary Object Lessons, p. 230–241. Let them be introduced as often as pupils weary of any employment.

22. 10. MANNERS AND MORALS.—Same as first term. See, also, Calkins's Primary Object Lessons, p. 349–358. Also, a little volume by Jacob Abbott, "Learning about Right and Wrong." Also, Sedgwick's "Morals of Manners."

23. 11. MISCELLANEOUS OBJECTS.—Same as first term; also, see Primary Object Lessons, from p. 26–35.

24. 12. CONSTRUCTION.—Extend the exercises of the preceding term to four and five straight sticks and straight lines. In addition to the uniform wooden bricks, supply pupils with wooden blocks, pillars, columns, etc., of various shapes and sizes, for building houses, arches, bridges, etc.

Music should be introduced two or three times each day if the teacher can sing, or if some of the older pupils can lead the others in singing.

SECOND SCHOOL YEAR.

FIRST TERM.

25. 1. READING AND SPELLING.—Review Charts I. and II., and continue the exercises as directed on p. 28, 30, and 31 of Manual. Go through Chart No. III. See Manual, p. 32–3, and begin Chart No. IV.; Manual, p. 35. Begin reading in Primer also. Occasional concert exercises as before. See, also, in this connection, the 10th division of exercises for this term—"Maxims and Mottoes." *Spelling.* See Manual, p. 30, 31, and 32. Accustom the pupils to tell what the words mean. Thus, when they spell "cat," let them tell what the word *cat* represents—that is, tell what a *cat* is.

26. 2. COUNTING.—Continue as before (2 and 14). Primary Object Lessons, p. 146–8. See, especially, Manual, p. 32. Let pupils use the Type Letter-cards, if they have them, to set up the *figures* representing the numbers, or let them print the figures on the blackboard or on their slates.

27. 3. PRINTING, DRAWING, AND **Writing**.—Same as before (3 and 15), and p. 31, 32, 34, and 52 of Manual. Also, if pupils are now familiar with the Roman letters, let them copy the words in script on Chart No. IX., thus beginning with writing. Use slate-pencils or lead-pencils for this purpose. It is to be expected that these sketches will be exceedingly rude at first, but they will amuse the pupils, and give freedom to the movements of the hand.

28. 4. ORAL COMPOSITIONS: LANGUAGE.—Review former exercises. Also see Manual, p. 31, 32. Continued correction of ungrammatical expressions.

29. 5. SIZE, FORM, **Lines, Measures,** and **Solids**.—Same as before. See, also, Primary Object Lessons, p. 160–165.

30. 6. COLOR.—Same as before. Continue selecting and matching colors. Through verses 1 and 2, Manual, p. 92–3. Chart No. XIII.

31. 7. ANIMALS.—Same as in preceding term. See, also, Calkins's Manual. Descriptions and anecdotes of the kinds of animals described. Lessons on Birds.

32. 8. PLANTS.—Continue the course marked out for the first term of the first year. Teach children to compare plants, and note their differences. Let them try to find two leaves of clover, or of any other plant, just alike, and *tell wherein* they differ. This will lead them to *observe*, carefully, a thousand particulars which would otherwise pass unnoticed, and also to put their ideas thus acquired into language.

33. 9. PHYSICAL EXERCISES.—Continued as before directed (9 and 21), but less frequent as pupils become older, and as their interest increases in other school exercises.

34. **10. Manners and Morals, Maxims and Mottoes.**—Same as before suggested (10, 22). Also, as pupils are now supposed to be able to read from Charts I., II., and III., and from the Type Letter-cards, take up the "Maxims and Mottoes" (see Manual, p. 295), one each day, and go through from No. 1 to 20. In the morning the teacher announces the maxim or motto for the day, and allows some pupil to set it up with the Letter-cards on the Composing-frame, or to write or print it on the blackboard, where it remains in view of the whole school. Before dismissing for the day the teacher calls on one or more pupils to rise and repeat the maxim, and tell its meaning if they can. Probably the younger pupils will not be able to accomplish much at present in this exercise; but after the teacher has drawn from them what ideas he can, he himself should illustrate and enforce the meaning.*

35. **11. Miscellaneous Objects.**—Review and enlarge upon the ground previously gone over. Name objects to children, and let them tell their *parts*. Thus, name the different parts of a house; of the human frame; of a table, window, watch, hat, sled, apple, peach, book, stove, chair, herb, tree, carriage, knife, etc.; names of the days of the week, months of the year; number of days in the week, weeks in the year, days in the year; meaning of couple, pair, brace, dozen, score, right, left, quire of paper, ream of paper, etc.

36. **12. Construction.**—Continue the exercises of the two preceding terms. The tangram may also be used. See Primary Object Lessons, p. 47. Marbles and balls should be provided for out-door exercises, and the pupils should be taught how to use them, with various exercises in tossing, bounding, and catching balls. Explain to them *why* the ball bounds. Show them how to make a goose-quill *air-gun*, and, in connection with its *use*, explain the elasticity of the air. Illustrate by compressing a piece of India-rubber and letting it spring back suddenly to its shape. Teachers need not be ashamed to exhibit an interest in *such* philosophical experiments.

Music should be introduced two or three times each day if the teacher can sing, or if some of the older pupils can lead the others in singing.

SECOND TERM.

37. **1. Reading, Spelling, and Elementary Sounds.**—Review and continue Charts III. and IV., as before directed, p. 32 and 35-6 of Manual; also Chart No. V., Manual, p. 38. Also read in the

* The teacher will find it convenient, and interesting to the pupils, to use the Composing-frame (with the Cards) for his *bulletin-board*. He writes, or tells an order to a pupil, and the latter places it on the *bulletin*.

Primer. Teach the elementary sounds of the vowels from Chart I. Thus, pointing to "cap," pronounce the word, and then give the sound of its vowel ă. Go over Chart I. in this manner. Occasional concert exercises as before. Give some attention to punctuation and capitals. See Manual, p. 39.

Spelling.—Continue spelling as before (25). Also see Manual, p. 33–4. Also spell orally the words on Charts I., II., and III., the teacher naming the word, and requiring the pupils to first pronounce it, and then spell it. Let pupils tell what each word means, as before. Spell orally, or with cards, the leading words used in the various lessons of the day.

38. 2. Counting, Adding, etc.—Continue as before (2, 14, and 26), and see, also, Primary Object Lessons, p. 148–153. Also p. 34 of preceding Manual.

39. 3. Drawing and Writing.—See Manual, p. 37, under head of "Printing and Drawing." On writing, see Manual, p. 51. Use pencils. Form the words on Chart No. IX., and also write in script the words on Chart No. I. For drawing, see Manual, p. 52.

40. 4. Oral Compositions: Language.—See exercises under this head, p. 33 of Manual, in connection with Chart No. III. Correct all faulty language.

41. 5. Lines, Measures, Forms, and Solids.—Continue as before (17, 29), and see, also, Primary Object Lessons, p. 165–173.

42. 6. Colors.—Same as preceding term; also through verses 3 and 4, p. 93 of Manual.

43. 7. Animals.—Same as in preceding terms (19, 31). Let pupils tell the names of as many kinds of *birds* as they can, describing them, telling where they have seen them, etc. Let them point out and name as many as they can on Chart No. XVII. Also continue the use of Chart No. XV. See Manual, p. 130–1. Anecdotes of the animals mentioned. See Calkins's Manual, lessons on Birds.

44. 8. Plants.—Continue the exercises as directed (8 and 32). Also take up the subject of the "Forms of Leaves," Chart No. XIX., more particularly, and let pupils find and bring in leaves of similar forms. They may now be told the terms descriptive of these forms. See Manual, p. 177 to 182. Chart No. XIX.

45. 9. Physical Exercises.—Continued as before (9, 21, 33). Battledoor and shuttlecock, and the excercise of throwing hoops, called "The Graces," may now be introduced where they can be carried on in the open air. They will give ease and grace of movement, and impart skill in execution. Connect philosophical explanations with battledoor and shuttlecock, as suggested under head of "Construction," in preceding term. The teacher should

now consult the system of Dr. Lewis, of Boston, and henceforth adapt it to the wants of his school.

46. **10.** Manners and Morals, Maxims and Mottoes.—Same as before suggested (10, 22, 34). See how many of the twenty, pupils can repeat and illustrate. Continue their daily use.

47. **11.** Miscellaneous Objects.—Review the ground previously gone over (23, 35), and take up the exercises in Calkins's Primary Object Lessons, p. 36–40.

48. **12.** Construction.—Continue the exercises before given under this head (12, 24, and 36). In addition, children may be interested in folding and cutting paper (newspaper will answer) in various patterns, and forming boxes, envelopes, etc. They may cut the paper with small paper-folders, after doubling it down, which will avoid the necessity of using any sharp instruments.

49. **13. Geographical.**—Introduce the exercises suggested on p. 82–3 of Manual, First, Second, and Third Lessons. See, also, Calkins's Primary Object Lessons, p. 162 to 166 and 242 to 248.

Music should be introduced two or three times each day if the teacher can sing, or if some of the older pupils can lead the others in singing.

THIRD SCHOOL YEAR.

FIRST TERM.

50. **1.** Reading, Spelling, and Elementary Sounds.—Reading from Charts IV., V., and VI. See Manual, p. 35–6, 38, and 39–40. Also read in Primer or First Reader. See Manual, p. 39. In elementary sounds, take up Chart No. VII., as directed in Manual, p. 43, and go as far as "Additional Exercises," p. 44. Attend to punctuation and capitals, Manual, p. 39, and occasional concert exercises.

Spelling.—Continue as before (25 and 37). See, also, Manual, p. 37–8. Also spell each day, orally or with the Letter-cards, the names of all leading words introduced in the reading lessons, and also those used in the various lessons of the day under the head of colors, animals, plants, etc. Let pupils tell their meaning.

51. **2.** Numbers.—Continue as before (2, 14, 26, and 38). See Manual, p. 34, 37, and 38. Let the teacher give additional exercises in counting, adding, and subtracting other *objects*, but using *figures* to represent them. See, also, Primary Object Lessons, p. 154, and preceding Manual, p. 40.

52. **3.** Drawing and Writing on slates and blackboard. See Manual, p. 38, 40, 50, 51. Let pupils continue writing the lessons on the early Charts in script, with Chart No. IX. before them. Writing in writing-books, from copies, may now be commenced, but a sharp and long *pencil* would be preferable to a *pen.* It

should be held as a pen. For drawing, see Manual, p. 52, and Chart No. X.

53. 4. ORAL AND **Written Compositions**: LANGUAGE.—Same as before (28, 40), and see, also, Manual, p. 36. Continue the correction of ungrammatical expressions, etc.

54. 5. LINES, MEASURES, FORMS, SOLIDS, **Weights**.—Same as before (17, 29, 41), and also Primary Object Lessons, p. 174–180, and the preceding Manual, p. 80, 81, and 89.

55. 6. COLORS.—Same as before (30, 42).—Let pupils bring in colored objects, cloths, worsted, etc., and tell what colors they most resemble—matching them first with the hand Color-cards, and then with the colors on Chart No. XIII.

56. 7. ANIMALS.—Continue as before (31, 43). Manual, p. 130–133, and Chart No. XV. Also use Chart No. XVII., and let pupils name and describe what reptiles and what fishes they have seen. Introduce the subject of **Insects**. See Calkins's Manual for lessons on insects. Interesting accounts of any of the animals mentioned should be given.

57. 8. PLANTS.—Continue in the course of the previous exercises (32, 44), and go through with the first six divisions of "Forms" on Chart No. XIX., learning their names as far as it can *easily* be done. See Manual, p. 178 to 186.

58. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

59. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before (10, 22, 34, 46). The teacher should be constantly accumulating new stories, incidents, etc., for illustration. Review maxims and mottoes, and continue their use. Manual, p. .

60. 11. MISCELLANEOUS OBJECTS.—Review the ground previously gone over. Teacher may exercise the pupils in naming the *qualities* of objects, and writing them on the blackboard, or setting them up with the Letter-cards. Thus an object may be (comparatively) long or short, broad, narrow, light, heavy, etc., and thus through all the varieties of form and size: similarly as to its color. Other qualities, as hard, soft, elastic, opaque, solid, hollow, etc. Name the objects, and let pupils tell and write down as many qualities as they can. The pupils may then form these qualities into oral compositions descriptive of the objects. Teacher may also name qualities, and pupils name their opposites. Thus the teacher names good, wet, hot, left, deep, loud, true, slow, up, hard, kind, broad, open, tame, light, poor, just, old, bitter, weak, round, narrow, healthy, polite, white, crooked, grateful, transparent, etc., etc. Pupils should tell the *uses* of things mentioned; for example, of leather, cloth, bucket, air, water, fire, sun, wood, paint, iron, stone, brick, pen, book, ink, clock, slate, ear, eye, mouth, tongue, nose, hands, feet, wings, knife, axe, hammer, nails, saw, chalk, sponge,

broom, pail, mirror, chimney, lead-pencil, newspaper, spade, hoe, plow, harrow, etc., etc. See, also, Calkins's Manual.

61. **12.** CONSTRUCTION.—Continue, occasionally, all the exercises previously suggested under this head (24, 36, and 48), and, additionally, show the pupils how to form water-wheels, wind-mills, etc. The younger pupils may get their parents or older pupils to construct these for them. Explain what makes the water-wheel turn—the force of the water; the wind-mill—the force of the air, etc. Explain why their wooden blocks, walls, etc., sometimes tumble down; why their marbles roll down hill; why water runs —rolls—down hill, etc.

62. **13.** GEOGRAPHICAL.—Continue the exercises of the preceding term (49), and take up Fourth and Fifth Lessons of Manual, p. 83. See, also, Primary Object Lessons, p. 166 to 173 and 248 to 263.

Music should be introduced two or three times each day if the teacher can sing, or if some of the older pupils can lead the others in singing.

SECOND TERM.

63. **1.** READING, SPELLING, AND ELEMENTARY SOUNDS.—Charts V. and VI. reviewed, and Manual, p. 38, 39, 40. Also Primer or First Reader. Occasional concert exercises as before. Attention to inflections, punctuation, capitals, etc. See Manual, p. 39 and 41. Elementary sounds through A and E, p. 44–5 of Manual, Chart VII. First Reader, and begin the Second. Continue spelling exercises as before directed (25, 37, and 50). The spelling-book may also now be introduced.

64. **2.** NUMBERS.—Continue as before (2, 14, 26, 38, and 51). See, also, Manual, p. 40, 41. Counting from 1 to 100, forward and backward. Use of numeral frame. Learn the Roman numerals from I. to L., and form them on the blackboard or on slates, or set them up with the cards to designate any given number. For exercises, let one pupil place any given number, say twenty-nine objects, of any kind, on the table; let another set up the words "twenty-nine" on the frame with the Letter-cards; let another set up the same in figures, "29;" and another set up the same with the Roman numerals, "XXIX."

65. **3.** DRAWING AND WRITING.—Continue as in the preceding term.

66. **4.** ORAL AND WRITTEN COMPOSITIONS: LANGUAGE.—Same as before (28, 40, 53). See, also, Manual, p. 33, 36, and 40. Attention to punctuation, capitals, inflections, etc., and constant correction of ungrammatical expressions.

67. **5.** LINES, MEASURES, FORMS, SOLIDS, WEIGHTS, SOUNDS.—Same as before (17, 29, 41, 54). Also, Primary Object Lessons,

p. 182–185. Charts Nos. XI. and XII., and Manual, p. 80, 81, and 89, with simple definitions of terms, p. 90, 91.

68. 6. COLORS.—Same as before (30, 42, 55), and also explain the Primaries, Secondaries, Tertiaries, Sub-Secondaries, and Sub-Tertiaries, from Chart No. XIV., Manual, p. 100, 101. Two or three lessons each week.

69. 7. ANIMALS.—Review the ground gone over, taking a general view of the mammalia, birds, reptiles, fishes, and insects, and finish the subject of No. 1, Chart XV. Go over, briefly, the lower half of Chart No. XV. Anecdotes, incidents, etc.

70. 8. PLANTS.—Continue as before directed (32, 44, 57), and go through with the last two divisions of Chart No. XIX., Manual, p. 186 to 189.

71. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

72. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59). Continue maxims and mottoes as far as practicable.

73. 11. MISCELLANEOUS OBJECTS.—Continue as before (23, 35, 47, and 60), the teacher preparing a variety of object-lesson exercises—taking up *common* objects—and being careful not to go beyond the capacity of his pupils. See Calkins's Manual of Object Lessons. If the teacher has a small collection of **minerals**, that subject may now be taken up. Pupils should first learn to distinguish and name the common metals—gold, silver, copper, iron, tin, lead, zinc, and *brass*, a compound of copper and zinc, and *bronze*, a compound of copper and tin. Let pupils tell their qualities and uses as far as they can. Specimens should be examined. See Calkins's Manual.

74. 12. CONSTRUCTION.—Continue all the previous exercises (24, 36, 48, and 61). Add new games and amusements, chiefly for out-door recreation; and, especially, introduce those which may be used to illustrate philosophical principles. Show them the construction of whistles, fifes, etc., telling them what kinds of wood they may get, what bark peels easily, at what season of the year, and why then. Show them how to make and raise a kite, and explain, in familiar language, how it is carried up in the air. See Fifth Reader, p. 350. Encourage pupils to make (out of school), or to get others to make for them, kites, water-wheels, wind-mills, fifes, whistles, ships, wagons, machines, etc. The teacher should spend as much time as possible, out of school, with his pupils, participating in their games and amusements, and giving them a proper direction.

75. 13. GEOGRAPHICAL.—Review the ground previously gone over (49 and 62), and continue in the order marked out on p. 86, 87, and 88 of Manual. See, also, Primary Object Lessons, p. 263 to 268.

Music as before directed.

FOURTH SCHOOL YEAR.

FIRST TERM.

76. 1. Reading, Spelling, and Elementary Sounds.—Continue the use of the blackboard, the Charts V. and VI., if necessary, and the Letter-cards, and proceed with the Readers. No word should be passed by until the pupil has a correct idea of its meaning *as used in the lesson.* Yet the pupil may understand the meaning of the sentence without being able to *define* each word separately. The latter is not so important as the former. Question pupils thoroughly on the meaning of each *sentence* rather than upon the mere abstract meaning of separate *words*. Pay particular attention to correct pronunciation, distinct articulation, inflections, emphasis, etc. Make a spelling lesson out of every reading lesson. See, also, Calkins's Programme in his Manual, 2d and 3d steps of 2d grade, etc. Elementary sounds reviewed, and continued through the vowel sounds, Manual, p. 45-6, Chart VII. Concert exercises, both in reading and in the elementary sounds. *Spell* all important words in the reading and other lessons. Regular lessons from the spelling-book. Also, continue as suggested (25, 37, 50, and 63).

77. 2. Numbers.—See previous suggestions (26, 38, 51, and 64). Mental arithmetic may now be taken up. Make all examples as *practical* as possible. Continue Roman numerals from L. to C., as directed for preceding term.

78. 3. Drawing and Writing.—For drawing, see Manual, p. 52-3, and Chart No. X. Let the pupil also draw the "forms of leaves," and forms of their margins, both from Chart No. XIX., and from Nature. It is supposed that they have already learned the appropriate terms descriptive of these forms. Continue writing from Chart No. IX., etc., and from writing-books.

79. 4. Written Compositions: Language.—Let pupils write compositions on the subjects of Natural History especially, which they have already gone over from the Charts, under the heading of "Animals," "Plants," etc.; also, in connection with such other subjects of study for the term as the teacher may select. This may include "Manners and Morals," "Maxims," "Miscellaneous Objects," "Construction and Collections," etc. See, also, the subject of "Compositions" throughout the Manual. Continue corrections of language, etc.

80. 6. Colors.—Continue the exercises as before (55, 68), and go through the semi-neutral colors, Manual, p. 101-2, Chart XIV. Also return to Chart No. XIII., and go through the exercises, Manual, p. 94-5.

81. 7. Animals.—Go over the subjects of Nos. 1, 2, and 3, Chart

XV., and Manual, from p. 130 to 141. Continue the subjects of Birds, Reptiles, Fishes, and Insects, as before. Also, describe briefly, and point out on the Chart, No. XVII., the first order of Birds, Manual, p. 170–1; the four orders of Reptiles, Chart No. XVIII., and Manual, p. 174–5.

82. **8.** PLANTS.—Review, and continue the course of the previous exercises (32, 44, 57, and 70); also, if it is the right season of the year, commence a critical examination of the different parts of a flower, and the classification of plants on the Linnæan System. See Manual, p. 189 to 193, and Chart No. XX.

83. **9.** PHYSICAL EXERCISES.—As before directed (9, 21, 33, 45).

84. **10.** MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72). Continue maxims and mottoes, and review, daily, those gone over.

85. **11.** MISCELLANEOUS OBJECTS.—Continue as before suggested (23, 35, 47, 60, and 73). Explain to pupils the three great divisions of Nature: the Animal Kingdom, the Vegetable Kingdom, and the Mineral Kingdom. Tell them all material objects that are not either animal or vegetable are called *minerals*. Let them tell what things, therefore, belong to the mineral kingdom—all which have not *organized* forms. All rocks are minerals; all soils also, unless they are formed by the partial decay of vegetable or animal substances. Teacher should have a cabinet of the principal *rocks*, and pupils should learn to recognize and name them.* See, also, Calkins's Manual—Minerals.

86. **12.** CONSTRUCTION: **Cabinet Collections**, etc. Continue such of the previous exercises as are of farther interest and utility (48, 61, and 74). Pupils may now begin to make collections of plants for herbariums. See Manual, p. 201. Separate collections of preserved specimens of leaves of as many kinds of trees as possible, with names of the trees; also, of different kinds of wood, in small blocks. Once each week, a half hour or more may be devoted to an examination of the *museum* thus collected, machines, instruments, etc. Questions and explanations.

87. **13.** GEOGRAPHICAL AND **Historical**.—Continue the geographical exercises as before suggested (49, 62, and 75). Also, begin now to draw from the pupils the history of the immediate neighborhood, or *School District*, in the following manner: 1. Let them tell the names of the residents, where they reside, on what streets, in what direction from the school-house, and how far from it. 2. The occupations of the inhabitants—as farmers, mechanics, mer-

* The writer hopes to make arrangements for providing cheap geological cabinets for school use. Very little can be done in giving pupils a knowledge of geology without the aid of a well-arranged cabinet; and with such aid pupils will almost teach themselves.

chants, manufacturers, etc. 3. Names and residences of the trustees, directors, or other school officers of the district, and their general duties. 4. Any historical incidents of the district or neighborhood that may be proper to be narrated.

Music as before directed.

SECOND TERM.

88. 1. READING, SPELLING, AND ELEMENTARY SOUNDS.—Same directions as before given. Review elementary sounds, and continue through p. 46–7 of Manual, Chart VII. Spelling as before directed (25, 37, 50, and 63).

89. 2. NUMBERS.—See previous suggestions (26, 38, 51, 64, and 77). Mental Arithmetic, Multiplication Table, etc. Exercises in rapid combinations of numbers should be introduced, and should be frequent; easy at first, and gradually increasing in difficulty. Thus: teacher repeats aloud and slowly, "2, add 3, add 10, subtract 5, multiply by 2," and pupils tell the result. Let the teacher devise a series of such combinations.

90. 3. DRAWING AND WRITING.—Continue as before (52 and 78). See, also, p. 52–3–4 of Manual, and Chart No. X. Make drawings of every thing on Chart No. XIX., and also copy the same forms from the natural objects, if possible. Writing continued.

91. 4. WRITTEN COMPOSITIONS: LANGUAGE.—See directions (66, 79). Require pupils to use the pocket blank-books, as suggested in the Manual, p. 17–18. Let them write *sketches* of most of their lessons.

92. 6. COLORS.—Review. Also the same as preceding term.

93. 7. ANIMALS. — Same as the preceding term. Also describe briefly and point out the birds in the second and third orders, Chart No. XVII., Manual, p. 171–2; also the first order of Fishes, Chart No. XVIII., and Manual, p. 175–6; also go over the subjects of Nos. 4 and 5, Chart XV., and Manual, p. 141–7.

94. 8. PLANTS.—Continue the course of the previous exercises (44, 57, 70, and 82). A critical examination of the parts of the flowers of various plants, etc. Also, take up, in familiar talks, the subject of the "Economical Uses of Plants," "Our Common Fruits," Manual, p. 209, through Apple, Pear, Peach, Quince, Plum, and Apricot, to p. 214, using the illustrations, Chart No. XXI. Also drawings, specimens, etc.

95. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

96. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84). Continue maxims and mottoes as far as practicable.

97. 11. MISCELLANEOUS OBJECTS.—Continue as before suggested (60, 73, and 85). Teachers should exercise their ingenuity in ar-

ranging suitable exercises under this head. Continue the subject of Minerals, if the teacher has a suitable cabinet. See, also, Calkins's Manual of Object Lessons. Call the attention of pupils to the subject of *trades*, *professions*, etc., and prepare for them Object Lessons relating to their different employments, such as the farmer, the blacksmith, the carpenter, the mason, the shoemaker, the merchant, the lawyer, the teacher, the printer, various manufacturers, etc.; the tools used by each, the products of each, etc., etc.

98. **12.** CONSTRUCTION: CABINET COLLECTIONS, etc.—Continue in accordance with directions for preceding term (61, 74, and 86). Collections of *Mosses* from the woods, and of *Lichens* from old fences and rocks, are very interesting. Many of these *plants* are exceedingly beautiful. By the aid of paste or glue they may be used to cover a cheap pine frame of a picture. They make a handsome border.

99. **13.** GEOGRAPHICAL AND HISTORICAL.—Continue the course of the previous exercises under this head (62, 75, and 87), making the historical henceforth keep pace with the geographical. The physical geography of the neighborhood—its natural history, productions, with its political geography, etc.—should be introduced as suggested, p. 85, 86, 87, and 88 of Manual. Call up the history of the early settlements made in the neighborhood, as far as possible, and bring down the general history of the neighborhood to the present time, ascertaining *when* the present families moved into the neighborhood, and whence they came. Historical incidents, etc.

Music as before directed.

FIFTH SCHOOL YEAR.

FIRST TERM.

100. **1.** READING, SPELLING, AND ELEMENTARY SOUNDS.—Same directions as for the fourth year. Pupils may also now be required to define separate *words* in the reading lesson. For this purpose each should be provided with a dictionary. Continue practicing upon the elementary sounds, as directed in the Manual, p. 43 to 48, Chart VII. Take up **Phonic Spelling** and **Phonetic Analysis**, Manual, p. 49, and Chart VIII. Continue the *spelling* exercises as before directed (25, 37, 50, and 63).

101. **2.** NUMBERS.—Continue throughout the remainder of the course in accordance with such plans as the teacher may adopt. See, also, previous suggestions (26, 38, 51, 64, 77, and 89). Rapid combination exercises, gradually more and more difficult. Thus: "2, add 3, add 10, subtract 5, multiply by 2, divide by 4." "10, add 8, subtract 5, add 7, multiply by 4, divide by 10." Let the teacher form numerous sets of such exercises adapted to the

capacities of his pupils. Slate arithmetic whenever the pupils are prepared for it. Frequent exercises.

102. 3. Drawing and Writing.—Continue as before (52, 78, and 90). For drawing, see, also, Manual, p. 54. Charts Nos. XXI. and XXII. furnish good copies. Copy from Nature as much as possible. Geometrical drawing may be commenced. See Manual, p. 54–5–6–7, and Chart No. X.* Writing continued.

103. 4. Written Compositions: Language.—See directions (66, 79, 91). Require pupils to use the pocket blank-books, as suggested in the Manual, p. 17–18. Written sketches, etc.

104. 6. Colors.—Review preceding exercises. Take up the Chromatic Scale, Chart XIV., and go through the "Exercises on the Primaries, Secondaries and Tertiaries," as directed, Manual, p. 103–4.

105. 7. Animals.—Review the ground previously gone over. Birds in the fourth and fifth orders, Chart No. XVII., and Manual, p. 172–3; second order of Fishes, Chart No. XVIII, Manual, p. 176–7; Insects, see Calkins's Manual. Also the subjects of Nos. 6, 7, 8, 9, and 10, Chart No. XV., Manual, p. 147 to 156.

106. 8. Plants.—Continue the course of the previous exercises (44, 57, 70, 82, 94). Examination and classification of plants on the Linnæan System, Manual, p. 193 to 198, Chart No. XX.; "Economical Uses of Plants," in familiar talks; the "*Common Fruits*," Manual, p. 214, through Grape, Currant, Filbert, Gooseberry, Raspberry, Blackberry, Strawberry, Nuts, etc., to p. 220, using the illustrations, Chart No. XXI., together with drawings by the pupils, specimens, etc. Pupils make written sketches.

107. 9. Physical Exercises as before directed (9, 21, 33, 45).

108. 10. Manners and Morals, Maxims and Mottoes.—Same as before suggested (22, 34, 46, 59, 72, 84). Continue maxims and mottoes as far as practicable.

109. 11. Miscellaneous Objects.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

110. 12. Construction: Cabinet Collections, etc.—Continue in accordance with previous suggestions (61, 74, 86, and 98). Collections of *minerals*—different kinds of rocks, etc.—for geological cabinets, may be commenced. Even if the *names* of the different rocks are not yet known by either teacher or pupil, an examination of specimens will still be valuable. Collections of shells may also be made. Fresh-water shells are abundant. In time, such collections will make not only a handsome, but a *valuable* school museum.

* For making these geometrical drawings on the *blackboard*, a pair of *blackboard compasses*, adapted to hold a chalk or talc pencil, is much needed. We hope some one will construct such an instrument.

111. 13. GEOGRAPHICAL AND HISTORICAL.—Extend geography and history to the whole town on the principles suggested (87 and 99), and pages 86, 87, and 88 of Manual.

Music as before directed. *Declamations.*

SECOND TERM.

112. 1. READING, SPELLING, AND ELEMENTARY SOUNDS.—Same directions as for preceding term. If the reading-books used be the School and Family Readers, and the subject should be the *Mammalia* (p. 87–242) in the Third Reader, let the pupils read with Chart No. XVI. before them. At the beginning of each lesson let some pupil point out on the Chart, and give an abstract of, the orders and families of the Mammalia as far as they have gone in their reading, and tell to which order, family, etc., the reading lesson of the day is to be assigned. Suggest to them the reading out of school of such books as Children's Picture-book of Quadrupeds, Hooker's Natural History to p. 115, and any other similar works. Whatever be the reading lesson of the day, as soon as it is finished let pupils close their books. Teacher should then call upon pupils to tell what they have been reading about, and to give in their own language an analysis of the lesson. Continue the *spelling* exercises as before suggested (25, 37, 50, and 63).

113. 2. NUMBERS.—Frequent combination exercises, reviews, etc. Also, continue as before suggested (64, 77, 89, and 101).

114. 3. DRAWING AND WRITING.—Draw outlines from engravings, and also copy from natural objects. Manual, p. 52–3–4. Continue geometrical drawings, Manual, p. 58–9, and Chart No. X. Writing continued.

115. 4. WRITTEN COMPOSITIONS: LANGUAGE.—See directions (66, 79, 91). Require pupils to use the pocket blank-books, as suggested in the Manual, p. 17–18. Written sketches, etc.

116. 6. COLORS.—Reviewing, together with the directions (104) for the preceding term, will be sufficient for the present term.

117. 7. ANIMALS.—Birds in the sixth and seventh orders, Chart No. XVII., and Manual, p. 173. Third order of Fishes, Chart No. XVIII., Manual, p. 177. Insects. Also the subjects of the remaining ten numbers of Chart No. XV., Manual, p. 156 to 162. As introductory to the reading lessons on the Mammalia, Third Reader, which are supposed to be taken up this term, point out, on Chart No. XVI., the four great divisions of the Animal Kingdom—Vertebrates, Articulates, Mollusks, and Radiates. Also point out and describe the different races of mankind.

The separate consideration of the subject of "Animals" may now be dropped, as it is continued from time to time, from this point forward, under the head of "Reading."

118. 8. Plants.—Continue as before directed (82, 94, 106). Examination and classification on the Linnæan System, Manual, p. 193 to 198. "Economical Uses of Plants," in familiar talks through the subject of "*Common Root Plants*," Manual, p. 220 to 226, and Chart No. XXI. Drawings by the pupils for illustrations.

119. 9. Physical Exercises as before directed (9, 21, 33, 45).

120. 10. Manners and Morals, Maxims and Mottoes.—Same as before suggested (22, 34, 46, 59, 72, 84). Leading principles in morals and religious duty may now begin to be more formally presented. They should always be illustrated by anecdotes, incidents, historical truths, etc., as far as possible. Remember the *parables* by which the Savior taught. The teacher should be constantly accumulating additional and appropriate maxims, mottoes, proverbs, wise sayings, etc., to add to the list.

121. 11. Miscellaneous Objects.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

122. 12. Construction: Cabinet Collections, etc.—Continue as before suggested (61, 74, 86, 98, and 110). Drawings by the pupils may now begin to be added to the school museum: among them neat drawings of the geometrical figures, Chart X. See Manual, p. 57–61. Also some of the five regular solid polyhedrons, cut out of pasteboard. See Manual, p. 62–3.

123. 13. Geographical and Historical.—Continue the course of exercises previously suggested (87, 99, and 111). Extend them to the county and state, or section of the state, in which you reside. This will call up both the early history and the early geography of that part of the country, and hence will lead to our early Indian wars and the War of the Revolution.

Music as before directed. *Declamations.*

SIXTH SCHOOL YEAR.

FIRST TERM.

124. 1. Reading, Spelling, and Elementary Sounds. — Read, spell, define, and analyze, as directed (76, 100, and 112). If the Fourth Book of the School and Family Readers be used, the division of "Physiology and Health" should be carefully read, and each lesson analyzed, with remarks from the teacher, enforcing principles. Continue the *spelling* exercises as before directed (25, 37, 50, and 63).

125. 2. Numbers continued (64, 77, 89, and 101). Combination exercises daily. Reviews, etc.

126. 3. Drawing and Writing.—Continue outline drawings from engravings, and draw from Nature. Geometrical drawings through p. 59, 60, and 61 of Manual, and Chart No. X. Writing continued.

127. 4. WRITTEN COMPOSITIONS: LANGUAGE.—See directions (66, 79, 91). See, also, the suggestions under the head of "Geographical and Historical," for the present term. Require pupils to use the pocket blank-books, as suggested in the Manual, p. 17–18.

128. 6. COLORS.—Review, and take up the "Exercises from the Scale on the Sub-Secondaries and Sub-Tertiaries," Manual, p. 104.

129. 8. PLANTS. — Continue as before directed (82, 94, 106, 118). Examination and classification on the Linnæan System, Manual, p. 193 to 198. "Economical Uses of Plants," in familiar talks, through the "Cereals or Corn-plants," Manual, p. 226 to 238. Use Chart No. XXI. Also drawings by the pupils and specimens for illustrations. Written sketches of lessons.

130. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

131. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

132. 11. MISCELLANEOUS OBJECTS.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

133. 12. CONSTRUCTION: CABINET COLLECTIONS, etc.—Continue as before suggested (74, 86, 98, 110, and 122), making collections of different kinds of wood, leaves, mosses, lichens, herbariums, geological cabinets; and constructing machines; the geometrical solids, making drawings, etc.

134. 13. GEOGRAPHICAL AND HISTORICAL. — Continue as before (111, 123). The more formal study of the geography of our whole country may now be taken up, with the aid of the geography and atlas. Its leading historical events may also be *told* the pupils in familiar talks, beginning with the story of Columbus; and pupils should be required to *write compositions* embracing the events thus narrated to them. This will effectually secure their attention to what is told them.

Music as before directed. *Declamations.*

SECOND TERM.

135. 1. READING, SPELLING, AND ELEMENTARY SOUNDS.—Continued as directed (25, 37, 50, 63, 76, 100, and 112).

136. 2. NUMBERS continued (64, 77, 89, and 101). Combination exercises. Reviews, etc.

137. 3. DRAWING AND WRITING.—Outline drawings, etc. Review geometrical drawings, Manual, p. 54 to 61. Make drawings for constructing the five regular polyhedrons, Manual, p. 61, 62. Writing continued.

138. 4. WRITTEN COMPOSITIONS: LANGUAGE.—See directions (66, 79, 91, 127). Require pupils to use the pocket blank-books, as suggested in the Manual, p. 17–18.

139. 6. COLORS.—Review the exercises, Manual, p. 103, 104, 105, and explain and illustrate the subject of "Tones," Manual, p. 105, 106, 107.

140. 8. PLANTS.—Continue as before directed (106, 118, 129). Examination and classification on the Linnæan System, Manual, p. 193 to 198. "Economical Uses" continued, in familiar talks, through the "Fruits of Warm Countries," Manual, p. 238 to 249; using Chart No. XXI., and drawings by the pupils, for illustrations, together with such specimens as can be obtained.

141. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

142. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

143. 11. MISCELLANEOUS OBJECTS.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

144. 12. CONSTRUCTION: CABINET COLLECTIONS, etc.—Continue in the same course as before (74, 86, 98, 110, 122, and 133). The teacher should now fill out the programme under this head according to the attainments and capacities of his pupils. A Saturday's ramble with his pupils—making collections, preserving specimens, etc.—might be made profitable, and should be made interesting.

145. 13. GEOGRAPHICAL AND HISTORICAL.—Continue the geographical and historical studies as before suggested (111, 123, and 134). Historical *talks*, narrating important events in our own history, with compositions describing the same.

Music as before directed. *Declamations.*

SEVENTH SCHOOL YEAR.

FIRST TERM.

146. 1. READING, SPELLING, AND ELEMENTARY SOUNDS.—Continued as directed (25, 37, 50, 63, 76, 100, and 112). If the pupils be reading the division of "Ornithology, or Birds," in the Fourth Reader, place before them Chart No. XVII., and follow the directions given for the Mammalia (112). In this manner pupils will soon acquire, and with but little effort, a familiarity with the scientific outlines of the subject. Suggest to them to read the "Children's Picture-book of Birds," and Hooker's "Natural History" from p. 115 to 187.

147. 2. NUMBERS continued (64, 77, 89, and 101). Combination exercises. Frequent reviews.

148. 3. DRAWING AND WRITING.—Continue drawings from engravings and from natural objects, and form the geometrical figures. Take up Linear Perspective, Manual, p. 63 to 70, first principles, and Chart No. X. Writing continued.

149. 4. WRITTEN COMPOSITIONS: LANGUAGE.—See directions (66,

79, 91, 127). Require pupils to use the pocket blank-books, as suggested in the Manual, p. 17–18. Sketches of lessons.

150. 6. COLORS.—Review, and go through "Hues of Colors," Manual, p. 107–8. Also exercises on "Complementary Colors," Manual, p. 109–110.

151. 8. PLANTS.—Continue as before directed (118, 129, 140). Examination and classification on the Linnæan System, Manual, p. 193 to 198. "Economical Uses" continued, in familiar talks, through "*Medicinal Plants*," Manual, p. 249 to 256, using Chart No. XXI., and drawings by the pupils, for illustrations, together with such specimens as can be obtained. Sketches of lessons.

152. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

153. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

154. 11. MISCELLANEOUS OBJECTS.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

155. 12. CONSTRUCTION: CABINET COLLECTIONS, etc.—According to the plan of the teacher. See suggestions (74, 86, 98, 110, 122, 133, and 144).

156. 13. GEOGRAPHICAL AND HISTORICAL.—Continue as before (111, 123, 134, and 145). History may now be taken up from the historical text-book. In connection with this study, we make the following suggestions on the subject of *Written Recitations*. Suppose the lesson, four pages in history, to have been given out yesterday, to be recited this morning. Suppose there are twelve pupils in the class, in four divisions. When the class is called, pupils bring their books and slates. Teacher assigns a page to each division; each pupil glances over his page hastily, and at a given signal all lay aside their books, take their slates, and each writes as full a sketch of the page assigned to him as he can. The teacher examines the slates, and merely marks errors (to be corrected), and graduates the pupils according to merit. The advantages which this exercise will often have over the common mode of recitation will be readily apparent to all.

Music as before directed. *Declamations*.

SECOND TERM.

157. 1. READING AND SPELLING.—See previous directions (25, 37, 50, 63, 76, 100, and 112). If the botanical division of the Fourth Reader be read, use in connection Charts XIX. and XX. Suggest to pupils to read Hooker's "Child's Book of Nature," Part I., Plants.

158. 2. NUMBERS continued (64, 77, 89, and 101). Combination exercises. Frequent reviews.

159. 3. DRAWING AND WRITING.—Continue as before (137, 148,

etc.), frequently reviewing. Linear Perspective through p. 70, 71, and 72.

160. 4. WRITTEN COMPOSITIONS: LANGUAGE: **English Grammar.**—See directions (66, 79, 91, 127). The separate study of English Grammar may now be introduced, but still in connection with the pocket blank-book exercises, as suggested in the Manual, p. 18.

161. 6. COLORS.—Review; also "Harmony of Colors," from p. 110 through p. 117, Manual.

162. 8. PLANTS.—Continue as before directed (129, 140, 151). "Economical Uses" continued, in familiar talks, through "*Plants used for Beverages,*" Manual, p. 256 to 266, using Chart No. XXII., and drawings by the pupils for illustration, with such specimens as can be obtained. In connection with the reading lessons in Botany, from the Fourth Reader, take up, in familiar talks, the "Natural Method of Classification," and go through "Polypetalous" and "Apetalous" plants, Manual, p. 198 to 204, Chart No. XX. Let pupils write *sketches* of all.

163. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

164. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

165. 11. MISCELLANEOUS OBJECTS.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

166. 12. CONSTRUCTION: CABINET COLLECTIONS, etc.—According to the plan of the teacher. See suggestions (74, 86, 98, 110, 122, 133, and 144).

167. 13. GEOGRAPHICAL AND HISTORICAL.—Continue both, as far in unison as possible. See suggestions (123, 134, 145, and 156). Frequent reviews.

168. 14. **Dictation Exercises.**—Read to the pupils brief interesting sketches, mostly narrative; and when you have concluded, let them write out the same, in the language of the book as nearly as possible. What is read should be suited to the ages and capacities of the pupils. The exercises will be found admirably adapted to cultivate close attention, to strengthen the memory, to give facility of expression, and to test the proficiency of pupils in spelling, punctuation, inflections, use of capitals, penmanship, etc. They may perhaps be commenced earlier than this period with some classes, and may be written by the younger pupils on slates, but the more advanced pupils should use pen and paper. The teacher corrects the exercises by marking all errors, and requires pupils to rewrite where necessary.

Music as before directed. Frequent *declamations.*

EIGHTH SCHOOL YEAR.

FIRST TERM.

169. 1. Reading and Spelling.—See directions (37, 50, 63, 76, 100, and 112). When the Natural Philosophy division of the Fourth Reader is read, suggest to pupils to read Mayhew's "Wonders of Science" and Mayhew's "Peasant-Boy Philosopher."

170. 2. Numbers continued (64, 77, 89, and 101). Combination exercises. Frequent reviews.

171. 3. Drawing and Writing.—Continue as before (137, 148, etc.), frequently reviewing. Linear Perspective through p. 73, 74, 75.

172. 4. Written Compositions: Language: English Grammar.—See directions (66, 79, 91, 127, 160). In studying English Grammar, reference should be had more to the acquisition of correct habits of speaking and writing than to the technicalities of *parsing*. It is better to show a mode of expression—such as "I intended to have gone yesterday"—to be *philosophically* wrong, than to show it to be merely a violation of an arbitrary *rule* of grammar.

173. 6. Colors.—Review the whole subject of colors, and go as far as Division XII., p. 123 of Manual.

174. 8. Plants.—Continue as before directed (140, 151, 162). "Economical Uses" continued, in familiar talks, through "*Plants used for Manufactures*," Manual, p. 266 to 274, using Chart No. XXII., drawings, specimens, etc., for illustration. Also "Natural Method of Classification," in familiar talks, Manual, p. 204, through "*Endogenous Plants*," p. 207, Chart No. XX.

175. 9. Physical Exercises as before directed (9, 21, 33, 45).

176. 10. Manners and Morals, Maxims and Mottoes.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

177. 11. Miscellaneous Objects.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

178. 12. Construction: Cabinet Collections, etc.—According to the plan of the teacher. See suggestions (74, 86, 98, 110, 122, 133, and 144).

179. 13. Geographical and Historical.—Continue in the course marked out in the previous suggestions (123, 134, 145, and 156). Frequent reviews. Begin the use of the *globes*.

180. 14. Dictation Exercises.—Same as in preceding term.

Music as before directed. Frequent *declamations*.

SECOND TERM.

181. 1. Reading and Spelling.—See directions (37, 50, 63, 76, 100, and 112). When the division on "Physiology and Health,"

in the Fifth Reader, is read, suggest to pupils to read Combe's "Principles of Physiology applied to the Preservation of Health."

182. 2. NUMBERS continued (64, 77, 89, and 101). Combination exercises. Frequent reviews. Slate arithmetic.

183. 3. DRAWING AND WRITING.—Continue as before (137, 148, etc.). Linear Perspective through p. 76, 77, 78.

184. 4. WRITTEN COMPOSITIONS: LANGUAGE: ENGLISH GRAMMAR.—See directions (160, 172).

185. 6. COLORS.—Review as before, and finish the subject of colors, Manual, p. 123 to 129.

186. 8. PLANTS.—Continue as before directed (151, 162, 174). "Economical Uses" continued, in familiar talks, through "*Miscellaneous*" plants, and plants used for "*Coloring*," p. 274 to 282, using Chart No. XXII., drawings, etc., for illustrations. Review "Natural Method of Classification," Manual, p. 198 to 209, Chart No. XX. After this period, the subject of "Plants" may be continued in connection with the reading lessons (see next term); or it may be continued by taking up the study of BOTANY from the regular botanical text-book.

187. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

188. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

189. 11. MISCELLANEOUS OBJECTS.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

190. 12. CONSTRUCTION: CABINET COLLECTIONS, etc.—According to the plan of the teacher. See, also, suggestions (74, 86, 98, 110, 122, 133, and 144).

191. 13. GEOGRAPHICAL AND HISTORICAL.—Continue in the course already marked out (123, 134, 145, 156, 179). Frequent reviews.

192. 14. DICTATION EXERCISES.—Continue as directed (168). *Music* as before directed. Frequent *declamations*.

NINTH SCHOOL YEAR.

FIRST TERM.

193. 1. READING AND SPELLING.—See directions (37, 50, 63, 76, 100, and 112). In connection with the botanical division of the Fifth Reader, place Chart No. XX. before the pupils. Before proceeding with the lesson, let some pupil point out on the Chart, and give an abstract of, the classes and families, as far as the class has gone. Suggest to pupils to read Gray's "How Plants Grow." They may also examine the introductory portions of Wood's or Lincoln's Botany.

194. 2. NUMBERS continued (64, 77, 89, and 101). Combination exercises. Frequent reviews. Slate arithmetic.

195. 3. DRAWING AND WRITING.—Continue in the course of pre-

vious exercises. Encourage pupils to form new plans in perspective, and also to make drawings of buildings from Nature, and to draw the same building from different positions.

196. 4. WRITTEN COMPOSITIONS: LANGUAGE: ENGLISH GRAMMAR. —See directions (160, 172).

Extend the subject into *rhetoric* proper, and begin a survey of *English literature* from some such work as Cleveland's "Compend." One hour, or more, each week may be devoted to these allied subjects, in lectures by the teacher, and *written sketches* by the pupils, where they can not be made subjects of regular study and recitation.

197. 6. COLORS.—Review the entire subject of colors.

198. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

199. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

200. 11. MISCELLANEOUS OBJECTS.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

201. 12. CONSTRUCTION: CABINET COLLECTIONS, etc.—According to the plan of the teacher. See, also, suggestions (74, 86, 98, 110, 122, 133, and 144).

202. 13. GEOGRAPHICAL AND HISTORICAL.—Continue in the course already marked out (123, 134, 145, 156, 179). Frequent reviews.

203. 14. DICTATION EXERCISES.—Continue as before directed (168).

Music as before directed. Frequent *declamations*. Elementary *book-keeping*.

SECOND TERM.

204. 1. READING AND SPELLING.—See directions (37, 50, 63, 76, 100, and 112). In connection with the division of Reptiles and Fishes in the Fifth Reader, use Chart No. XVIII., pointing out the divisions as directed for the Mammalia, Birds, etc. (112, 146).

205. 2. NUMBERS continued (64, 77, 89, and 101). Combination exercises. Frequent reviews. Slate arithmetic.

206. 3. DRAWING AND WRITING.—Continue as before directed (137, 148, 195, etc.). Review Perspective.

207. 4. WRITTEN COMPOSITIONS: LANGUAGE: ENGLISH GRAMMAR. —See directions (160, 172).

Rhetoric and *English literature*.—See suggestions of preceding term (196).

208. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

209. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

210. 11. MISCELLANEOUS OBJECTS.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

211. 12. CONSTRUCTION: CABINET COLLECTIONS, etc.—According

to the plan of the teacher. See, also, suggestions (74, 86, 98, 110, 122, 133, and 144).

212. 13. GEOGRAPHICAL AND HISTORICAL.—Continue in the course already marked out (123, 134, 145, 156, 179). Frequent reviews.

213. 14. DICTATION EXERCISES.—Continue as before directed (168). These may, with propriety, be extended to many important subjects that can not be taken up as regular studies, such as popular *astronomy*, *mental philosophy* (such as Abercrombie's work), a description of the *arts*, or *technology* (Bigelow's work), the science of *government*, and especially our town, county, state, and national governments.

Music as before directed. Frequent *declamations*. Elementary *book-keeping*.

TENTH SCHOOL YEAR.

FIRST TERM.

214. 1. READING AND SPELLING.—See directions (37, 50, 63, 76, 100, and 112). In connection with the division of Natural Philosophy in the Fifth Reader, pupils may read out of school Faraday's "Physical Forces"—a course of six lectures; also, examine Wells's "Science of Common Things," Porter's "Familiar Science," etc. In connection with the division of Physical Geography, suggest to them to read Summerville's "Physical Sciences," or Guyot's "Earth and Man." On this and kindred subjects, Humboldt's "Cosmos," 5 vols. 12mo, is a suitable work for advanced students.

In connection with *spelling*, take up the analysis of derivative and compound words. See M'Elligott's "Young Analyzer," and "Analytical Manual."

Natural Philosophy may now be carried beyond the Fifth Reader, and taken up as a *study* from the regular text-book in schools where it can be introduced in this manner.

215. 2. NUMBERS continued (64, 77, 89, and 110). Combination exercises. Frequent reviews. Slate arithmetic.

Algebra may now be introduced, where the school is sufficiently well *graded* to render it feasible.

216. 3. DRAWING AND WRITING.—Continue as before directed (137, 148, 195, 206).

217. 4. WRITTEN COMPOSITIONS: LANGUAGE: ENGLISH GRAMMAR.—See directions (160, 172).

Rhetoric and *English literature* as before suggested (196).

218. 9. PHYSICAL EXERCISES as before directed (9, 21, 33, 45).

219. 10. MANNERS AND MORALS, MAXIMS AND MOTTOES.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

220. **11.** Miscellaneous Objects.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

221. **12.** Construction: Cabinet Collections, etc.—According to the plan of the teacher. See, also, suggestions (74, 86, 98, 110, 122, 133, and 144).

222. **13.** Geographical and Historical.—Continue in the course already marked out (123, 134, 145, 156, 179). Frequent reviews.

223. **14.** Dictation Exercises.—Continue as before directed (168). See, also, suggestions (213).

Music as before directed. Frequent *declamations*. Elementary *book-keeping*.

SECOND TERM.

224. **1.** Reading and Spelling.—See directions (37, 50, 63, 76, 100, and 112). In connection with the division of Chemistry in the Fifth Reader, suggest to pupils to read Hooker's "First Book in Chemistry," and Faraday's "Chemistry of a Candle." In connection with the division of Geology, Hugh Miller's "Old Red Sandstone," and Hitchcock's "Scripture and Geology."

The analysis of derivative and compound words as before (214).

Natural Philosophy, as a regular study, as before suggested (214).

225. **2.** Numbers continued (64, 77, 89, and 101). Combination exercises. Frequent reviews. Slate arithmetic.

Algebra may be continued, and *geometry* taken up.

226. **3.** Drawing and Writing.—Continue as before directed (137, 148, 195, 206).

227. **4.** Written Compositions: Language: English Grammar.—See directions (160, 172).

Rhetoric and *English literature* as before suggested (196).

228. **9.** Physical Exercises as before directed (9, 21, 33, 45).

229. **10.** Manners and Morals, Maxims and Mottoes.—Same as before suggested (22, 34, 46, 59, 72, 84, and 120).

230. **11.** Miscellaneous Objects.—Continued in accordance with previous suggestions (60, 73, 85, and 97), five minutes daily.

231. **12.** Construction: Cabinet Collections, etc.—According to the plan of the teacher. See, also, suggestions (74, 86, 98, 110, 122, 133, and 144).

232. **13.** Geographical and Historical.—Continue in the course already marked out (123, 134, 145, and 156). Frequent reviews.

233. **14.** Dictation Exercises as before directed (168 and 213).

Music as before directed. *Declamations*. *Book-keeping*.

Remarks.—The teacher who has gone through the present Manual, and examined the course of instruction presented in the foregoing "Programme," will get our views of what a system of "object" teaching

should be, and of the extent to which it should be introduced into our schools. We have seen some objections to the system by those who evidently do not understand its principles, and who erroneously suppose it to consist of oral instructions by the teacher about "common things;" and many teachers, indeed, who profess to be practicing it, and who take this superficial view of it, are bringing the system itself into disrepute. Hence some are beginning to regard the system as one of mere *amusement* for the child, or a system of *learning made easy*, that requires no close mental application, and gives no mental discipline.

But we believe any sensible person who will look over the amount and character of the work marked out for the pupil, from the tender age of four years, in the foregoing programme, will admit that great mental activity and industry will be required to go through such a course. He will see that this "object" system, which is here introduced so early, and is peculiarly adapted to childhood, is, indeed, the very *opposite* of inculcating lazy habits of thought in children by doing the thinking for them, for it is made pre-eminently the office of the teacher in this system to *lead the pupil to think* instead of *telling* him every thing. If by this system study is made attractive, it does not necessarily follow that idle amusements are made to take the place of study. If amusements are made to minister to mental activity in the acquisition of knowledge, it is so much additional gain. By the untiring, persevering mental effort which the system strives to call forth, beginning with the early and constant exercise of the perceptive faculties, the mind is sought to be strengthened, on the principle of the great *law* of labor. If it is not, therefore, when carried out in accordance with our views, an admirable system of mental gymnastics for the young, we wholly misconceive its tendencies.

Nor is *science* made every thing in this system, as some suppose. It is only a part of its course; and even then it is made an *instrument* only, while the ultimate aim is mental culture, which, however, brings with it, more peculiarly in this system than in any other, a knowledge of sensible objects—of their character and qualities, and of the beauty, wisdom, goodness, and truth which God exhibits in his works. Assuredly that science which leads "from Nature up to Nature's God" is not useless knowledge, nor does it undermine faith, as those ignorant of science imagine, but, on the contrary, strengthens and supports it.

It will, however, doubtless strike some who have *practiced* "object" teaching, but who understand little of its true principles, that in the foregoing Programme and Manual we have not confined ourselves strictly to a system of *mere* "Object Lessons." We have designed the work as a "Manual of Instruction" for the whole field of primary education, and have introduced "object" teaching only where we thought it adapted to the subject, and the subject suited to the ages of the pupils. And while we do *not* believe that *true* object teaching can be carried too far,

and while we *do* believe that it is the only system adapted to the unfolding faculties of childhood, we as firmly believe that there are some of the more advanced subjects of study to which it is not applicable; for there are some subjects which, although they may often be *illustrated* by material things, do not, like the natural sciences, deal directly with material objects. But we believe such a course of elementary training in "object" teaching as we have attempted to sketch in the present volume, in connection with the *model lessons* given in Mr. Calkins's "Manual," will, if carried out in the right manner by the teacher, lay the very best and only true foundation for a mental superstructure in which all science, all art, and all literature shall be found combined in harmonious proportions. We would begin with science—a knowledge of the world around us—just as Nature begins her teachings, instead of putting off science to the last thing in education, where it is generally neglected entirely; and the fine arts should crown the edifice. We would also have pupils, from the very beginning, employ their faculties, and make *use* of their knowledge, by *descriptions* of things, in a series of "Oral Compositions," which should give place to the frequent use of the *pen*, and searching analysis, as the course advances. Gradually the exercises in any department or study should lead onward, by easy gradations, to the hardest set *tasks*, requiring the severest mental labor, but never in advance of the progressive attainments of the pupil. Let teachers be impressed with the idea that the true "object" or *development* system should be regarded, primarily, as a *means of mental culture*, and not merely as a medium of acquisition; and in all their school exercises let them study how best to awaken observation, secure attention, improve the memory, develop *thought*, and cultivate the reason; for thus only will the great ends of education be attained.

II. MAXIMS AND MOTTOES, APHORISMS AND PROVERBS, FOR THE SCHOOLROOM.

The genius, wit, and spirit of a nation are discovered in its *maxims* and *proverbs*.—*Bacon.*

Proverbs are, for the most part, rules of moral, or, still more properly, of prudential conduct.—*Brande.*

Proverbs embody the current and practical philosophy of an age or nation.—*Fleming.*

A *proverb* is the wit of one, and the wisdom of many.—*Lord John Russell.*

These things have I spoken unto you in *proverbs*.—*John*, xvi., 24.

And he spake many things unto them in *parables*.—*Matt.*, xiii., 3.

The first and most ancient inquirers into truth were wont to throw their knowledge into *aphorisms*, or short, scattered, unmethodical sentences.—*Bacon.*

Exclusively of the abstract sciences, the largest and worthiest portion of our knowledge consists of *aphorisms*.—*Coleridge.*

Proverbs are the gatherings of ages. Like pebbles smoothed by the flood, they have flowed down the stream of time, divested of extraneous matter, rounded into harmonious couplets, or clenched into useful *maxims*. Less ornate and redundant than the productions of modern literature, they are far more instructive; they are the manual of practical wisdom compiled from the school of experience, and are thus the very salt of all knowledge; and their precepts, as the actual results of life, circumstance, and occasion, are far preferable to the erring deductions of the speculative inquirer.—*Thos. Fielding.*

Proverbs embrace the wide sphere of human existence; they take all the colors of life; they are often exquisite strokes of genius; they delight by their airy sarcasm or their caustic satire, the luxuriance of their humor, the playfulness of their turn, and even by the elegance of their imagery, and the tenderness of their sentiment. They give a deep insight into domestic life, and open for us the heart of man in all the various states he may occupy. A frequent review of proverbs should enter into our readings.—*Curiosities of Literature.*

With the above commendations of *proverbs*—a general term under which may be included maxims, mottoes, aphorisms, apophthegms, adages, wise sayings, saws, etc.—we would suggest a caution against their too frequent use, *except as media of instruction*, and also against the use of such as are not elegant and refined. Although once considered the ornaments of conversation, they are no longer so regarded by the polite, probably because they at one time became so *common;* but, in the language of D'Israeli, "they have not ceased to be the treasures of *thought*." They may be made to subserve a most excellent purpose in school instruction. See the foregoing Programme:

1. To be happy you must be good.
2. A kindness is never lost.
3. A wise son maketh a glad father.
4. Scorn to do a mean action.
5. Honesty is the best policy.
6. Never give a hasty reply.

7. In most quarrels there is a fault on both sides.
8. A little neglect may cause great mischief.
9. A small spark may kindle a great fire.
10. A confessed fault is half mended.
11. Do unto others as you would have them do to you.
12. Do what you ought, come what may.
13. Time will bring to light whatever is hidden.
14. Trifles often lead to serious matters.
15. Truth is the highest ornament of youth.
16. Lying lips are an abomination to the Lord.
17. Merit will surely meet with a reward.
18. A boy is known by the company he keeps.
19. He who fears God does not fear man.
20. The fear of the Lord is the beginning of wisdom.
21. The angry man is a madman.
22. It is sport to a fool to do mischief.
23. A fool always finds a greater fool to admire him.
24. Learning is better than houses, lands, or money.
25. A place for every thing, and every thing in its place.
26. One ill word asketh another.
27. Show me a liar, and I'll show you a thief.
28. One lie begets another.
29. Oil and truth will get uppermost at last.
30. A good name will shine forever.
31. A liar is not to be believed though he speak the truth.
32. Kind speeches comfort the heavy hearted.
33. A soft answer turneth away wrath.
34. Where there is a will there is a way.
35. None so deaf as those that will not hear.
36. When one *will* not, two can not quarrel.
37. It is the second blow that makes the fray.
38. The way to be truly honored is to be truly good.
39. The more we serve God, the better we serve ourselves.
40. The credit that is got by a lie only lasts till the truth is out.
41. So long as you are ignorant, be not ashamed to learn.
42. Small faults indulged are little thieves that let in greater.
43. Manners and learning make a gentleman.
44. Goodness always enriches the possessor.
45. Kind words cost nothing, but are worth much.
46. He is idle who might be better employed.
47. He who resolves to do right has God on his side.
48. Lazy folks take the most pains.
49. Idleness is the parent of vice and misery.
50. A good word for a bad one is worth much and costs little.
51. Anger begins with folly and ends in sorrow.

52. Be always more ready to forgive than to return an injury.
53. Experience is a dear school, but fools will learn in no other.
54. Application in youth makes old age comfortable.
55. A fault is made worse by endeavoring to conceal it.
56. An angry man opens his mouth and shuts his eyes.
57. A wager is a fool's argument.
58. An oak is not felled with one blow.
59. Better to be alone than in bad company.
60. Doing nothing is doing ill.
61. A jest is no argument.
62. A drowning man will catch at a straw.
63. A good name is better than riches.
64. All is not gold that glitters.
65. A rolling stone gathers no moss.
66. Every man is the architect of his own fortune.
67. He that will not be counseled can not be helped.
68. He that does you an ill turn will never forgive you.
69. Learning makes a man fit company for himself.
70. Little and often fills the purse.
71. Little strokes fell great oaks.
72. Make the best of a bad bargain.
73. One eyewitness is better than ten hearsays.
74. One is not so soon healed as hurt.
75. An ounce of prevention is worth a pound of cure.
76. Say well is good, but do well is better.
77. The worth of a thing is best known by the want of it.
78. What can not be cured must be endured.
79. Yielding is sometimes the best way for succeeding.
80. A promise against law or duty is void in its own nature.
81. A liar is a bravo toward God, and a coward toward men.
82. A man that breaks his word bids others be false to him.
83. A good life keeps off wrinkles.
84. Amendment is the best sign of repentance.
85. After praying to God not to lead you into temptation, do not throw yourself into it.
86. Constant occupation prevents temptation.
87. Envy shoots at others and wounds herself.
88. Example teaches more than precept.
89. He that swells in prosperity will shrink in adversity.
90. If every one would mend *one*, all would be mended.
91. Ignorance is a voluntary misfortune.
92. Contempt will sooner kill an injury than revenge.
93. An idle brain is the devil's workshop.
94. A bad wound heals; a bad name kills.
95. A bad workman quarrels with his tools.

96. A blithe heart makes a blooming visage.
97. A burden which one chooses is not felt.
98. A faithful friend is a strong defense.
99. A flatterer is a most dangerous enemy.
100. A fop is the tailor's friend and his own foe.
101. A friend is never known till needed.
102. A friend in need is a friend in deed.
103. A great fortune is a great slavery.
104. An evil conscience is the most unquiet companion.
105. A man forewarned is forearmed.
106. Advise not what is most pleasant, but what is most useful.
107. A penny saved is a penny earned.
108. A small leak will sink a great ship.
109. A stitch in time saves nine.
110. A young man idle, an old man needy.
111. Affectation is at best a deformity.
112. Affectation is part of the trappings of folly.
113. Better face a danger than be always in fear.
114. Before you promise, consider what you can perform.
115. Avoid that which you blame in others.
116. Beggars have no right to be choosers.
117. Be slow to promise, and quick to perform.
118. Birds of a feather flock together.
119. Civility is a charm that attracts all men.
120. By doing nothing we learn to do ill.
121. Command your temper, lest it command you.
122. Drive thy business, or thy business will drive thee.
123. Every day of your life is a leaf in your history.
124. Do nothing to-day that you are likely to repent of to-morrow.
125. Deeds are fruits; words are but leaves.
126. Deep rivers flow in silence; shallow brooks are noisy.
127. Do nothing you would wish to conceal.
128. Empty vessels make the greatest sound.
129. Among the base, merit begets envy; among the noble, emulation.
130. A few books well chosen are of more use than a great library.
131. Acquire honesty; seek humility; practice economy; love fidelity.
132. Against fortune oppose courage; against passion, reason.
133. A clear conscience fears no accuser.
134. A good cause makes a stout heart and a strong arm.
135. Affectation in dress implies a flaw in the understanding.
136. A passionate man rides a horse that runs away with him.
137. A gentle disposition is like an unruffled stream.
138. A great man will neither trample on a worm nor sneak to a king.
139. Apprehension of evil is often worse than the evil itself.
140. By reading we enrich the mind, by conversation we polish it.

141. A wounded reputation is seldom cured.
142. Better to suffer without cause than to have cause for suffering.
143. Begin nothing until you have considered how it is to be finished.
144. Be cautious of believing ill, but more cautious of reporting it.
145. By entertaining good thoughts you will keep out evil ones.
146. Courage without conduct is like a ship without ballast.
147. Cherish thy friend, and temperately admonish thy enemy.
148. Leave not for another what you can better do yourself.
149. Close not your eyes at night till you have opened your lips in prayer.
150. Two things a man should never be angry at: what he *can* help, and what he *can not* help.
151. Envy can not see; ignorance can not judge.
152. Every body's business is nobody's business.
153. Evil communications corrupt good manners.
154. Every man who does a secret injury is a coward.
155. False friends are worse than open enemies.
156. Follow the wise few rather than the vulgar many.
157. Fortune can take nothing from us but what she gave.
158. The wicked flee when no man pursueth.
159. God helps those who helps themselves.
160. Good counsel is above all price.
161. Grudge not another that which you can not attain yourself.
162. He that is over-hasty fishes in an empty pond.
163. He who avoids the temptation avoids the sin.
164. He who masters his passions conquers his greatest enemy.
165. Hope long deferred maketh the heart sick.
166. He who says what he likes, must hear what he does not like.
167. He who spends all he gets is on the high road to beggary.
168. If the counsel be good, no matter who gave it.
169. It is less painful to learn in youth than to be ignorant in age.
170. If you wish a thing done, go; if not, send.
171. Ill will never spoke well.
172. It is never too late to learn.
173. Little boats must keep near shore;
Large ships may venture more.
174. Lose no opportunity of doing a good action.
175. Let not the sun set upon your anger.
176. Mildness governs better than anger.
177. Necessity is the mother of invention.
178. Never sport with pain or poverty.
179. Nothing is so secret but time and truth will reveal it.
180. Pardon others often, thyself seldom.
181. Prudence guides the wise, but passion governs the foolish.
182. Punishment and reward are like the bridle and spur.

183. Quarrels are easily begun, but with difficulty ended.
184. Resist a temptation till you conquer it.
185. Rich men depend on the poor, as well as the poor on them.
186. Reform those things in yourself that you blame in others.
187. Sneer not at that you can not rival.
188. So live with men as if God saw you.
189. Sands form the mountain; moments make the year.
190. Study mankind as well as books.
191. Speak as you mean, do as you profess, and perform what you promise.
192. Temperance is the best medicine.
193. Some act first, think afterward, and repent forever.
194. The hand of the diligent maketh rich.
195. Time, patience, and industry are the three great masters of the world.
196. The greater the difficulty, the more glory in surmounting it.
197. Those who plot mischief live in fear and die miserable.
198. Unmerited honors never wear well.
199. Unprincipled men live knaves and die beggars.
200. We are bound to be honest, but not to be rich.
201. Virtue is a garment of honor, but wickedness a robe of shame.
202. Vanity makes men ridiculous; pride, odious.
203. When men speak ill of you, live so that nobody will believe them.
204. What sculpture is to a block of marble, education is to the mind.
205. The wise man knows he knows but little; the fool thinks he knows all.
206. He injures the good who spares the bad.
207. Every fool can find faults that a great many wise men can't mend.
208. A fool can ask questions that a wise man can not answer.
209. Buy what you do not want, and you will sell what you can not spare.
210. The wise man knows the fool, but the fool knows not the wise man.
211. The worth of a thing is best known by the want of it.
212. The devil goes away when he finds the door shut against him.
213. Help yourself, and heaven will help you.
214. Those who live in glass houses should not throw stones.
215. He who would catch fish must not mind getting wet.
216. A thousand probabilities will not make one truth.
217. By others' faults wise men correct their own.
218. Strike the iron while it is hot.
219. Make hay while the sun shines.
220. He who rises late never does a good day's work.
221. He that shows his passion tells his enemy where to hit him.
222. He that would thrive must rise at five.
He that has thriven may lie till seven.

223. He that peeps through a hole may see what will vex him.

224. Forbid a fool a thing, and that he'll do.

225. To believe a business imposible is the way to make it so.

226. Never make a mountain of a molehill.

227. Patience is bitter, but the fruit is sweet.

228. God tempers the wind to the shorn lamb.

229. Better go around than fall into the ditch.

230. He who thinks to deceive God has already deceived himself.

231. Time is a file that wears and makes no noise.

232. Between virtue and vice there is no middle path.

233. He that would eat the kernel must not complain of cracking the nut.

234. There is nothing so bad as not to be good for something.

235. One to-day is worth two to-morrows.

236. Error is worse than ignorance: for while the latter is a blank sheet on which we may write, the former is a scribbled one on which we must first erase.

237. Those who value themselves merely on their ancestry have been compared to potatoes, as *all that is good of them is under ground.*

238. An upright minister asks, *What* recommends a man; a corrupt minister, *Who.*

239. Virtue without talent is a coat of *mail* without a *sword;* it may, indeed, defend the wearer, but will not enable him to protect his friend.

240. There are none so weak that we may venture to injure them with impunity; and there are none so *low* that they may not at some time be able to return a kindness and repay an obligation.

241. The excesses of our youth are drafts upon our old age, payable with interest about thirty years after date.

242. There are three modes of bearing the ills of life: by indifference, which is the most common; by philosophy, which is the most ostentatious; and by religion, which is the most effectual.

243. Variety is the relaxation of a great mind, and amusement its repose.

244. If you wish to recommend yourself to a great and good man, take care that he quits your society with a good opinion of *you;* if your object is to please a vain man, take care that he leaves you with a good opinion of *himself.*

245. Murmur not at misfortunes: if our ills can be cured, it is ungrateful; if they can not be, it is vain.

246. In any art trifles make perfection, but perfection is no trifle.

247. The only thing which we are sure to want happens to be the only thing which we never purchase—our coffin!

248. Wealth is a relative thing; since he that has little, and wants less, is richer than he that has much, and wants more.

249. While pride makes some men ridiculous, it prevents others from becoming so.

250. He that can please nobody is not so much to be pitied as he whom nobody can please.

251. Deliberate with caution, but act with decision; and yield with graciousness, or oppose with firmness.

252. Whoever dreads punishment, suffers it; and whoever deserves it, dreads it.

253. If you will not hear Reason, she will surely rap your knuckles.

254. Some are very busy and yet do nothing.

255. Physicians rarely take medicine, and lawyers seldom go to law.

256. He that wants health wants every thing.

257. The poor man walks to get meat for his appetite, the rich man to get appetite for his meat.

258. Sickness is felt, but health not at all.

259. Good-nature is natural politeness.

260. Nothing but religion is capable of changing pains into pleasures.

261. It is more honorable to acknowledge our faults than to boast of our merits.

262. Is it not astonishing that the love of repose keeps us in continual agitation?

263. How benevolent are misers! They amass wealth for those who wish their death!

264. When we can not find contentment in ourselves, it is useless to seek it elsewhere.

265. Have the courage to obey your Maker at the risk of being ridiculed by man.

266. Have the courage to show your preference for honesty in whatever guise it appears, and your contempt for vice surrounded by attractions.

267. Have the courage to admit that you have been in the wrong, and you will remove the fact from the mind of others.

268. Have the courage to wear your old garments till you can pay for new ones.

269. Have the courage to own that you are poor, and you disarm poverty of its sharpest sting.

270. Have the courage to do without that which you do not need, however much you may admire it.

271. Have the courage to speak your mind when it is necessary that you should do so, and the self-control to hold your tongue when it is better that you should be silent.

272. Have the courage to shut your eyes at the doubtful prospect of large profits, and to be content with the certainty of small ones.

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